Ohio Environmental Protection Agency

Division of Drinking and Ground Waters

Backflow Prevention and Cross-Connection Control

Fourth Edition – 2015

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MANUAL

OF

BACKFLOW PREVENTION

AND

CROSS-CONNECTION CONTROL

Ohio Environmental Protection Agency

P.O. Box 1049

Columbus, Ohio 43216-1049

Fourth Edition, 2015

PREFACE TO THE FOURTH EDITION

This is a manual of good engineering practices for the protection of potable water systems from contamination by backflow. It is specifically written for use in Ohio, incorporating the laws and administrative rules of the State of Ohio. This manual is also intended for use as a self-training manual for water supply personnel and others involved in cross-connection control. Although this manual discusses all aspects of backflow prevention and cross-connection control, its main emphasis is promoting Ohio EPA's mission and assisting public water systems in protecting public water supplies. The requirements outlined in this manual apply to the protection of the public water supply under the authority outlined in Ohio EPA's rules and regulations. Material contained herein referencing protection of the consumer's water system plumbing, is for informational purposes only. The reader, if performing under the purview of the Ohio Depart of Commerce, should reference the Ohio Department of Commerce's, Division of Industrial Compliance, Construction Compliance manual, "Backflow Prevention and Cross-Connection Control Manual: For the Education of Ohio Certified Backflow Prevention Technicians" for guidance.

The first edition was published in 1976. The second edition, which was published in 1977, included an update of the citation numbers of the Ohio Administrative Code (OAC) rules pertaining to backflow prevention and cross-connection control and error corrections. The third edition remained essentially the same in structure and content as the previous editions, but included additional corrections and substantial revision in some areas. This fourth edition has been updated to reflect the current OAC rules and to provide recent guidance and policies that include recent examples of cross-connection and backflow incidents. Also, additional illustrations were provided for visual reference. The Table of Contents lists titles for the major topics covered.

An effort has been made throughout this fourth edition to improve the organization of the manual, in order to make it more useable for the reader.

2015

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SECTION 1 – THE PROBLEM

The existence of our present day civilization depends on the availability of safe public water systems. Visualize any medium-sized or large municipality without a public water system, trying to grow or even continuing its level of existence. Water systems have been developed over a period of years and are now taken for granted. The universal acceptance of public water systems as being safe can lull us into complacency with a feeling that all the work in the area has been completed and that our water systems have reached the ultimate in safety. This is not true. It is necessary to continue the surveillance of these systems in order to maintain the level that has been reached and we must work even harder to improve these present supplies. This publication deals with an area where continuous vigilance is needed – backflow prevention and cross-connection control.

The use of water-flushed sewage systems has developed at about the same rate as our public water systems. Unfortunately, the use of such sewage systems can create a hazard to our public water systems through backflow between the two systems. Since drinking water is provided at sinks, toilets, bathtubs, and similar plumbing fixtures, it is obvious that in order to prevent the contamination of the public water system such a fixture must be designed and installed in such a way that flow can be only in the direction intended. Plumbing codes are written to protect our health by protecting our drinking water. Plumbing fixtures and drainage systems are designed using methods and devices prescribed by plumbing codes in order to make the combined supply-disposal system function properly and safely. Those not familiar with cross-connection control or backflow prevention can quickly and easily convert a safe water supply into an unprotected or unsafe supply without realizing that a hazard has been created. These hazards may manifest themselves immediately after they have been created or they may lie dormant for a long time until the right chain of circumstances triggers a disastrous situation.

In addition to sewage backflow, many other possible hazards exist. Pressurized systems carrying impure process water, caustics, acids, fertilizer, or other hazardous substances can be connected to the drinking water supply through aspirators or pumping devices. Dual water supplies for fire control systems can also create hazards. Homeowners, previously served by private wells who have since tied into a public water system, may find it difficult to abandon their wells because of the money invested. Such cross-connections between an individual water supply of unknown quality and a public water system creates a potential hazard to the public water system.

Two basic types of backflow exist. One is caused by the cross-connection of a public water system with another pressurized system. The other is caused by a vacuum from siphon action. It is obvious that when a second system's pressure is higher than the pressure in the public water system, the contents of the second system will be forced into the public water system. A closed valve or check valve in the system cannot be relied on to stop this flow. Valves are not watertight 100% of the time. Valves can develop leaks due to normal wear. A leaky valve may pose a risk to human health.

The hazard created by a connection between two pressurized systems is compounded when the pressure in the public water system drops. The problem is further aggravated if the public water system develops a vacuum. Many circumstances can cause a drop in pressure or the development of a vacuum in a pressurized water system and these conditions do develop, periodically and unexpectedly.

A vacuum condition may develop in portions of a distribution system by a high volume water use or by a broken water main or an open fire hydrant. These vacuum conditions not only compound the problems between pressure systems, but also may contaminate systems by allowing flow through any unprotected opening connected to the public water supply. Common examples include hose bibs or threaded faucets where a hose is attached.

Many hazards can be found in industrial plants, factories, schools, hospitals or any location that is served by a public water system. The examples of backflow incidents that follow have occurred in Ohio. They show the need for additional work in the cross-connection elimination/protection program in order to protect our public water systems from contamination.

1. August 2000 – Northeast Ohio

   Contaminated drinking water at a county fairground caused an E. coli outbreak. The Center for Disease Control (CDC) linked 27 northeast Ohio cases of E. coli 0157:H7 to contaminated water and ice served by eight to twelve food vendors during the last three days of the fair. CDC theorized that standing water in the animal barns was siphoned into the public water system through garden hoses that were lying in the water.

2. February 2004 – Central Ohio

   Company officials discovered a cross-connection between the public water supply and a coolant line that drew water from holding ponds. A normally closed valve that linked the two piping systems was found to be open. It was revealed that the valve was actually opened in the past in the summer when the water in the holding ponds got too hot to cool the factory's heavy machinery. Cold public water was then drawn into the coolant system.

   Company employees called the local health department claiming the company's drinking water was contaminated as turbid water was noted in toilet bowls. Drinking fountains were subsequently shut down and bottled water was provided. The two systems were physically separated. It remains undetermined whether the valve was deliberately opened with the intention of physical harm.

3. August 2004 – Northwest Ohio

   A local county health department contacted the Ohio Department of Health to report an unusually large number of people experiencing gastrointestinal illness after visiting a popular vacation destination. A multi-agency investigation was coordinated including the Ohio Department of Health, Center for Disease Control, Ohio Department of Agriculture and Ohio EPA.

   The investigation revealed substantial groundwater microbiological contamination across the entire area. The investigation also found 20 businesses that were connected to the Village public water system also had private wells. Four of the wells were found to be physically connected to the public water system. Eleven of the wells tested total coliform positive and four tested both total coliform positive and e-coli positive.

   The Village was ordered to implement a backflow program in accordance with Ohio regulations. Although it was not conclusively determined that cross-connections created the increase in gastrointestinal illnesses, no incidents have been reported since the backflow program was implemented.

4. October 2004 – Northeast Ohio

   An elementary school notified the Village water department of smelly water and restrooms plugged with green 'stringy stuff'. The Emergency Management Agency, village officials, and the local Fire Chief were notified and a "No Use" advisory was issued for the entire Village. Nine hundred residents were instructed to use bottled water after the Village public water system was contaminated with fertilizer.

A contractor was planting grass on a dam and encountered a problem with backflow while filling his truck with water to a mixture of grass seed, mulch, fertilizer and a stabilizing product (lime). Without authorization, he had hooked up a fire hose to a hydrant inside the fence at the water treatment plant. The contractor stated that he was told the truck had an air gap so a backflow preventer was not needed at the hydrant. Upon inspection, it was found that the truck actually had a direct connection to the water source with no air gap.

5. April 2008- Southwest Ohio

   A leaking reduced pressure principle backflow assembly in a state institution left 109 inmates without water to sinks and stools for three days. Maintenance personnel shut off the water to an entire cellblock because a backflow preventer was leaking directly onto the floor (without a floor drain). This decision demonstrated the need for improved communication strategies with the Operator of Record. It also showed the lack of general knowledge of backflow preventers, their purpose, functionality and their testing, maintenance and repair needs.

SECTION 2 – BACKFLOW AND CROSS-CONNECTION THEORY AND CONCEPTS

Backflow is the flow of water or other liquids, mixtures, or substances into the distributing pipes of a potable water supply from any source other than the intended source of the potable water supply.

A cross-connection is any physical link or route that makes it possible for contamination to flow into the potable water system. While a cross-connection provides the physical link, there must also be a pressure differential that acts to force the contamination into the potable water system. Backflow will occur when the pressure in the potable water system is lower than the pressure in the system containing the contamination. The physical link could be a drain line, a hose dropped into a mud puddle, a sprayer attached to a bathtub faucet, or any other condition that would allow flow of a contaminant into the potable water supply. Backflow will also occur across a service connection to the public water system thereby introducing contamination into the public drinking water supply.

The potential hazard of backflow occurring in almost any public water system is quite possible. In many homes, factories and public buildings the existence of improper plumbing connections present cross-connections that may, under certain conditions, make it possible for water to flow the “wrong way”. The probability of backflow occurring at any given outlet may be very small, but due to the large number of possible situations, the probability becomes significant and must be proactively addressed.

BACKFLOW DUE TO BACKPRESSURE

Backflow can occur when there is a cross-connection between a public water system and a second system of pipelines, tanks, or similar equipment containing water or other liquids under a pressure greater than that in the public system at the point of interconnection. Such cross-connections may make it possible for quantities of dangerous materials to enter the public water system. Pumps on secondary or auxiliary installations are a primary cause of backflow and can be found at a variety of premises.

A typical cause of backflow is best illustrated (Figure 1) by visualizing a private well on a customer’s property which is also connected to the public water system. If the well is capable of producing a higher pressure than the city pressure, then the well may discharge water through the internal plumbing system into the city mains. If the well is contaminated, the danger is not only to the individuals in the immediate building, but also to other persons using the public water system.

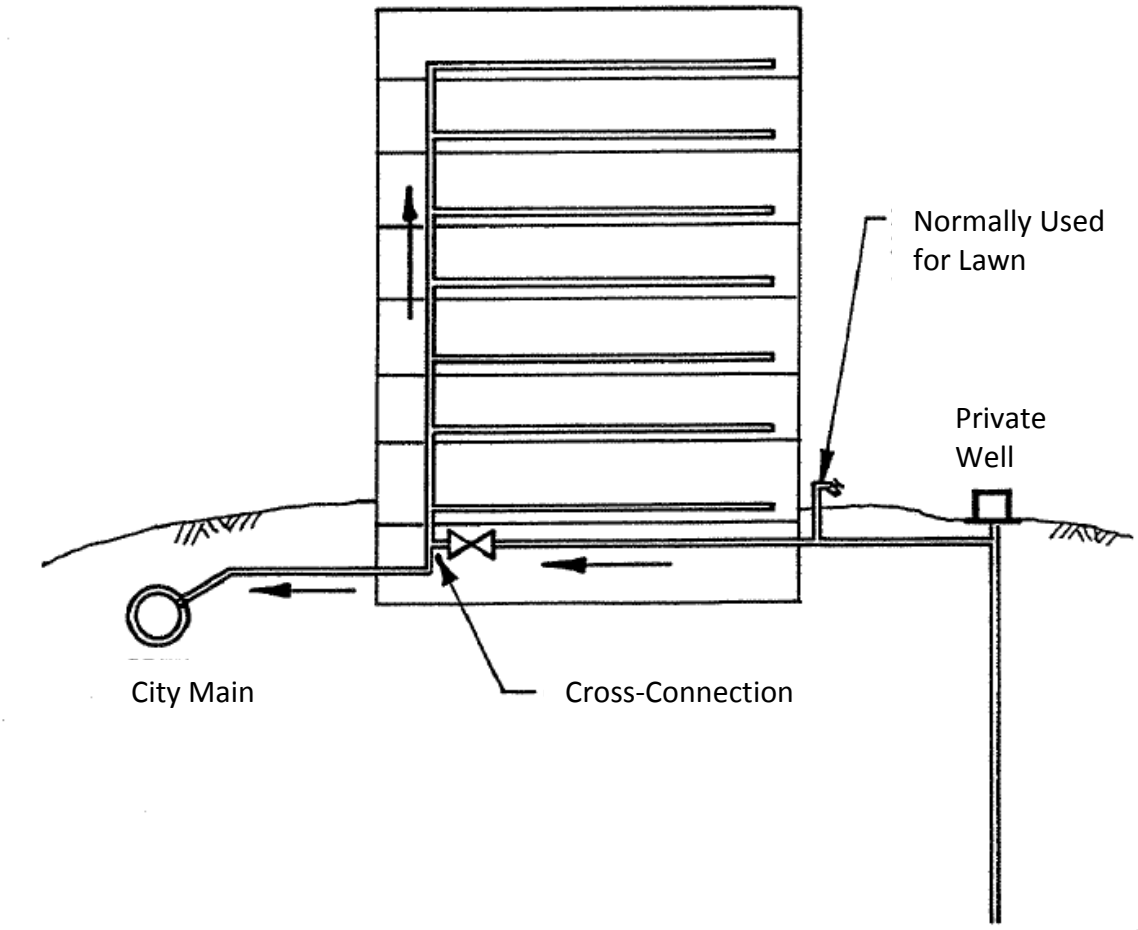


Figure 1. Example of Cross-Connection between the Public Water Supply and an Auxiliary Water Supply.

Another common hazard can be found in sewage or storm water pumping stations, sewage treatment plants, and other installations where large pumps are used to handle sewage or industrial wastes. These pumps often require a continuous water supply to provide a water seal for the pump packing. Should a supply line be connected directly to the pump, a serious cross-connection hazard will be created, which is potentially capable of permitting hazardous materials to enter the water system (Figure 2A). Accepted practice requires that an air gap be provided at the service connection with a small pump drawing from the receiving tank to supply the water seal. Figure 2B indicates how a cross-connection of this type could be eliminated.

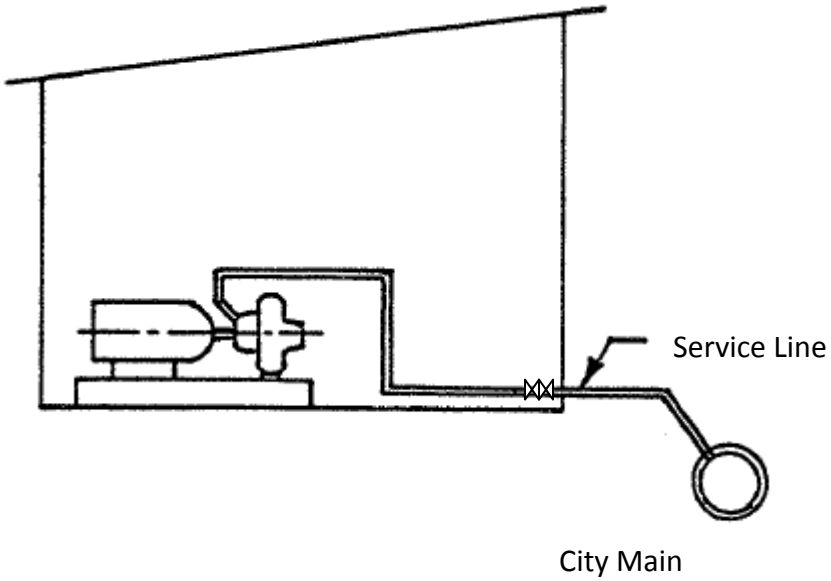


Figure 2A. Incorrect - Pump Water Seal at Wastewater Treatment Plant

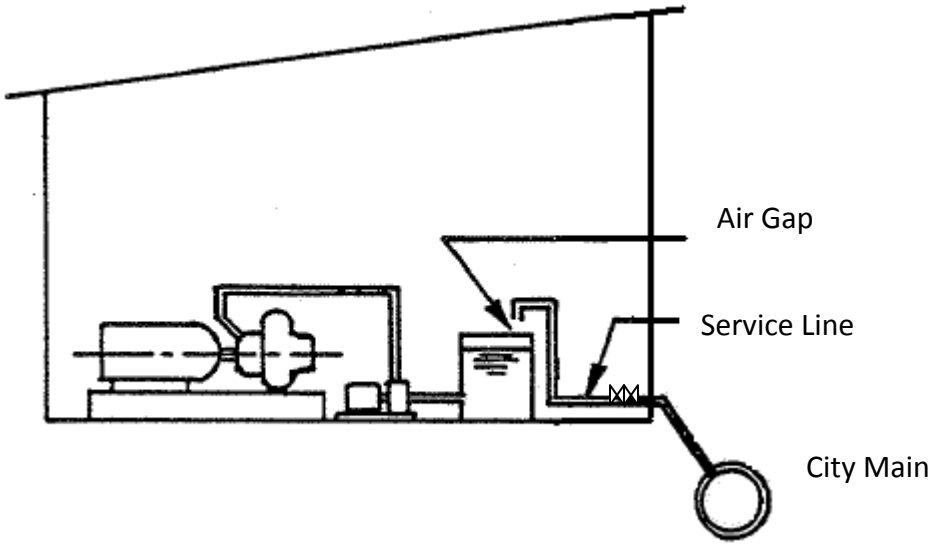


Figure 2B. Correct - Pump Water Seal at Wastewater Treatment Plant.

Figure 2B illustrates an air gap at the service connection to prevent backflow from the wastewater pump. If mitigated to the satisfaction of the supplier of water, when a service connection supplies other taps in the building, the point of supply at the wastewater pump may be isolated with an air gap and tank configuration. This configuration allows for supply pressure from the public water system to be maintained for the other taps, while still protecting against contamination from the wastewater pump. The air gap must be maintained and additional protection is necessary by installation of a reduced pressure principle backflow prevention assembly at the public water supply service connection.

Figure 3 illustrates how backflow may result from a ship connecting to a water main from a City's public water system. The ship has a separate non-potable system, which is interconnected with the public system. If the valve separating the two systems is accidentally left open, contaminated water from the ship could be pumped into the City's public water system.

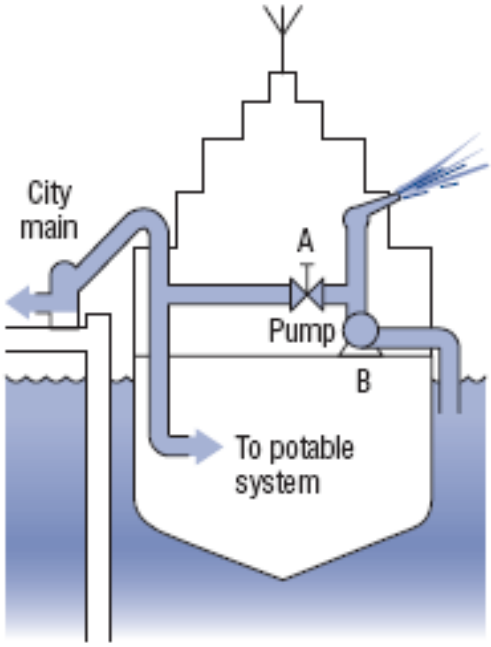


Figure 3. Cross-Connection between Public Water Supply and Ship's Fire Protection System

Often factories or commercial buildings will have an auxiliary water supply for fire sprinkler systems (Figure 4). If the auxiliary supply is cross-connected with the public water system, a potentially hazardous backflow situation is created if the auxiliary fire pump operates at a pressure exceeding that of the public water system.

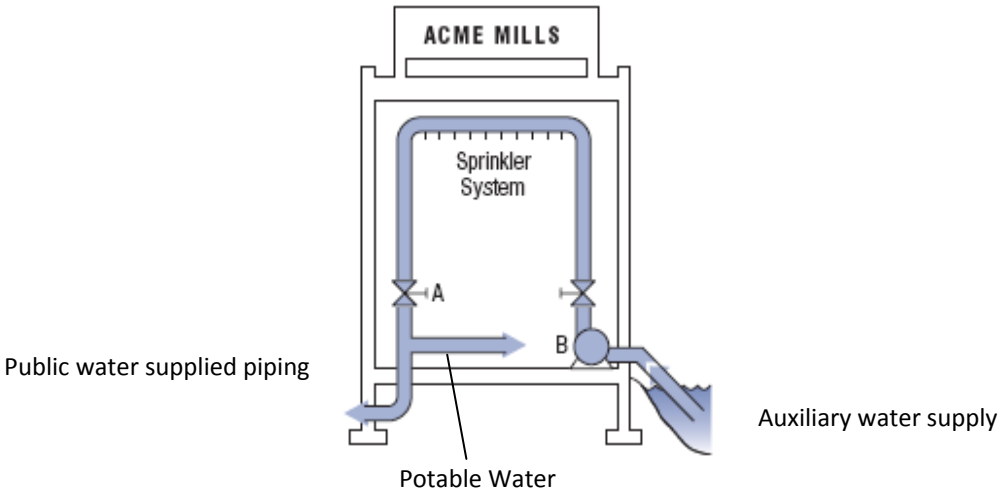


Figure 4. Cross-Connection between Public Water Supply and Auxiliary Water for Fire Protection Sprinkler System

BACKFLOW DUE TO BACKSIPHONAGE

Backsiphonage is a siphon action in a direction that would allow a hazardous liquid to enter the potable water supply system. It is caused by atmospheric pressure pushing against the hazardous liquid, forcing it into a potable water supply system that contains zones, which are under less than atmospheric pressure.

The air surrounding the earth has a weight sufficient to exert a pressure of 14.7 pounds per square inch (psi) at sea level. This atmospheric pressure is equivalent to the pressure exerted by a column of water 34 feet high. Figure 5A shows the theoretical balance between atmospheric pressure and a column of water.

This balancing of forces is also shown in Figure 5B. When a long tube closed at one end is filled with water and inverted in an open container of water, the water level in the tube will be higher than the water level in the open container. The weight of the atmosphere pressing down on the surface of water in the container can hold up a column of water 34 feet high.

Pressure less than atmospheric pressure is called negative pressure or vacuum. Pressure is commonly expressed in pounds per square inch (psi). It may be referred to an absolute scale (psia) where the “zero” represents absolute vacuum or to a gauge scale (psig) where the “zero” represents the atmospheric pressure.

Negative gauge pressure or vacuum can occur when there is a difference in water levels at two separate points within a closed piping system. This effect can be seen in Figure 5C using the column of water described in Figure 5B. A vacuum is created in the column when it is filled with water to expel the air and inverted in the container of water.

The pressure at the base of the column is 14.7 psia. Between the base and the top of the column, the pressure decreases with increasing height, showing that a negative pressure or vacuum exists in the column. Above 34 feet, the water column is broken and the space is filled with water vapor at nearly zero psia.

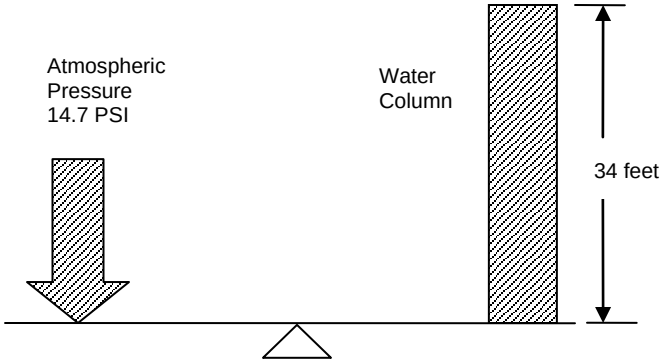


Figure 5A. Theoretical balance between atmospheric pressure and a column of water

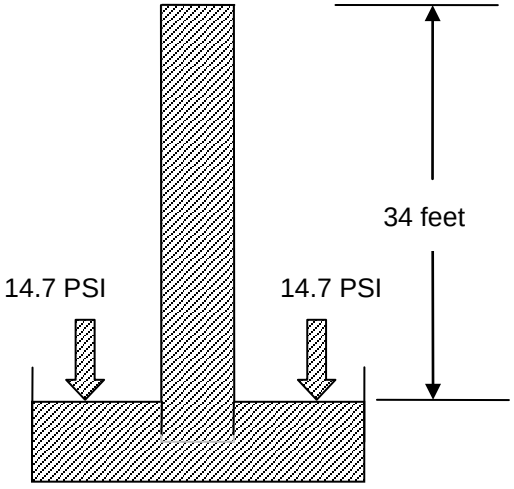


Figure 5B. Force of atmospheric pressure allows a column of water to rise 34 feet.

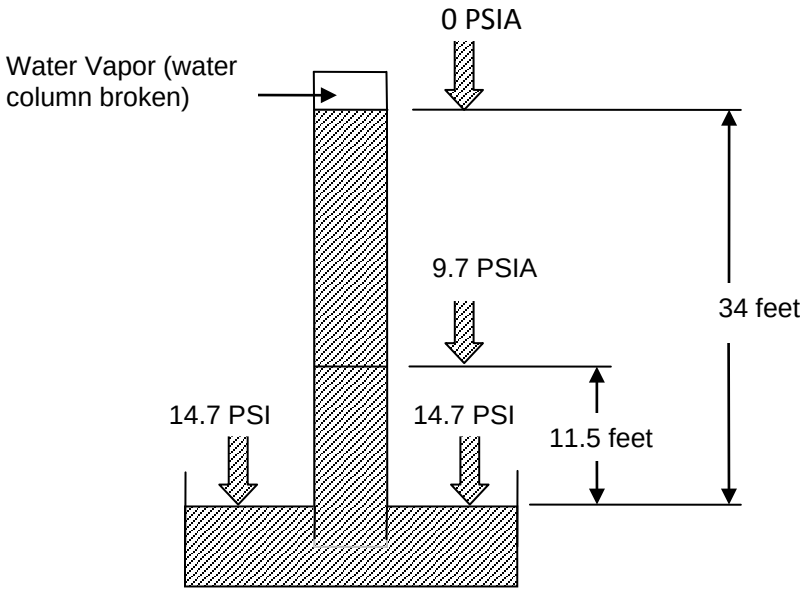


Figure 5C. Column of water broken at height over 34 feet.

Siphon action in a potable water supply system can occur when there is a difference in the free water level at separate points within a closed piping system. Figure 6A. shows the principles of operation of the siphon. Atmospheric pressure is acting on the surfaces of the water in the open containers at A and D. A partial vacuum has been created in the piping by first filling it with water to expel all of the air within the pipe. In the absence of flow, the vacuum at point C would be equivalent to distance H. Since H is greater than H_1, the vacuum at point C would be greater than that at point B. This difference in pressure will cause the water to flow from A to D or from an area of low vacuum to an area of high vacuum. This flow will continue until the water level at A drops below the end of the tube and the entrance of air into the filled pipe breaks the siphoning action.

Figure 6B illustrates how this siphon action can be hazardous in a potable water supply system. Atmospheric pressure acts at the open faucet and at the tank with a submerged inlet, which is located at a higher level. If the supply valve is closed or the pressure in the supply pipe drops sufficiently, a partial vacuum will occur in the riser pipe supplying the faucet and the tank. However, in the absence of flow the vacuum in the riser will be greater than the vacuum in the hose supplying the tank. Flow will occur by siphon action from the tank to the open faucet.

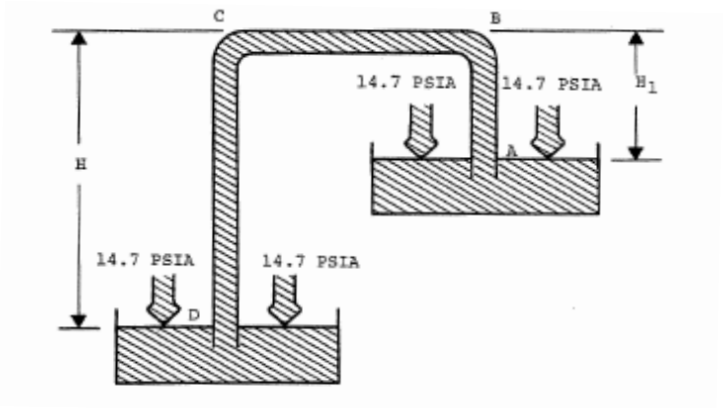


Figure 6A. Concept of a siphon created by difference in elevations.

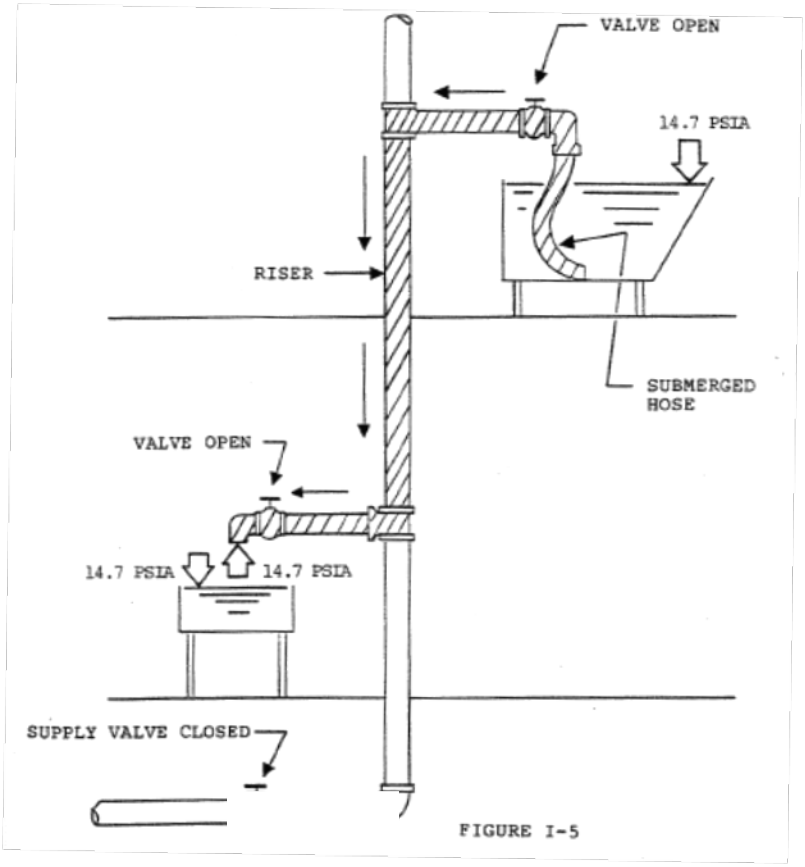


Figure 6B. Example of backsiphonage through a submerged hose facilitated by the vacuum created from the elevation difference.

Backsiphonage can occur when negative pressure develops either in the water user's piping system or, in the public water system mains. If plumbing defects exist in the consumer's piping system, siphoned water can contaminate the public water system. In public water systems, negative pressures can be caused by main breaks, planned or emergency shutdowns, fire demands, water use exceeding the hydraulic capabilities of the system, etc.

Negative pressures in building piping systems can occur as a result of low pressure in the public water system and because of insufficient hydraulic capacity within the buildings. Negative pressures will occur more frequently at the highest points in both buildings and in distribution systems. Thus, large volumes of water used on the lower floors of a building may cause backsiphonage of water from the upper floors. Similarly, with a public water distribution system in hilly terrain, high water consumption or main breaks may result in negative pressures developing at high points.

The following are some examples of cross-connections where conditions for potential backsiphonage exist. Many of these can be readily found in homes.

Spray Hose in Sink

If there is a vacuum created in the water supply line while the nozzle end of a spray hose is submerged in a sink full of water, polluted water can be siphoned from the sink into the potable water supply or the public water system (PWS) through a leaking nozzle unless the supply fixture is equipped with an acceptable backflow prevention device (Figure 7A and 7B).

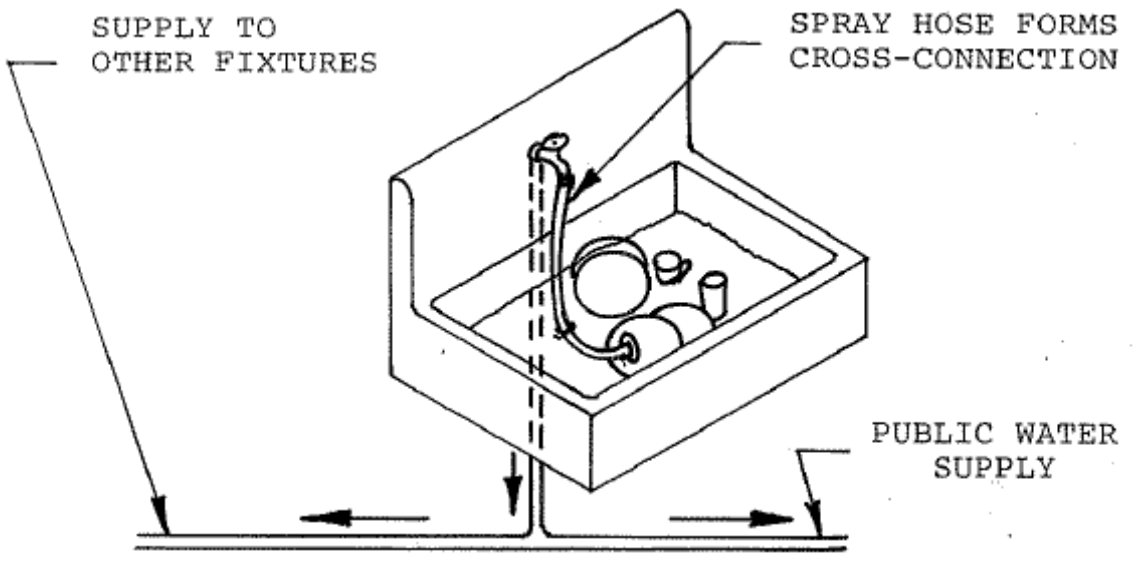


Figure 7A. Spray Hose Attached to Sink Faucet

Figure 7B. Hose attachments in sink.

Submerged Inlets

Many old commercial sinks, old soda fountains, old dishwashers and automatic laundry machines may have submerged water supply inlets. When the water supply inlet is located below the flood level rim of the basin and a vacuum occurs in the potable water supply, wastewater can be siphoned back into the potable or public water supply through open or leaking supply valves (Figure 8).

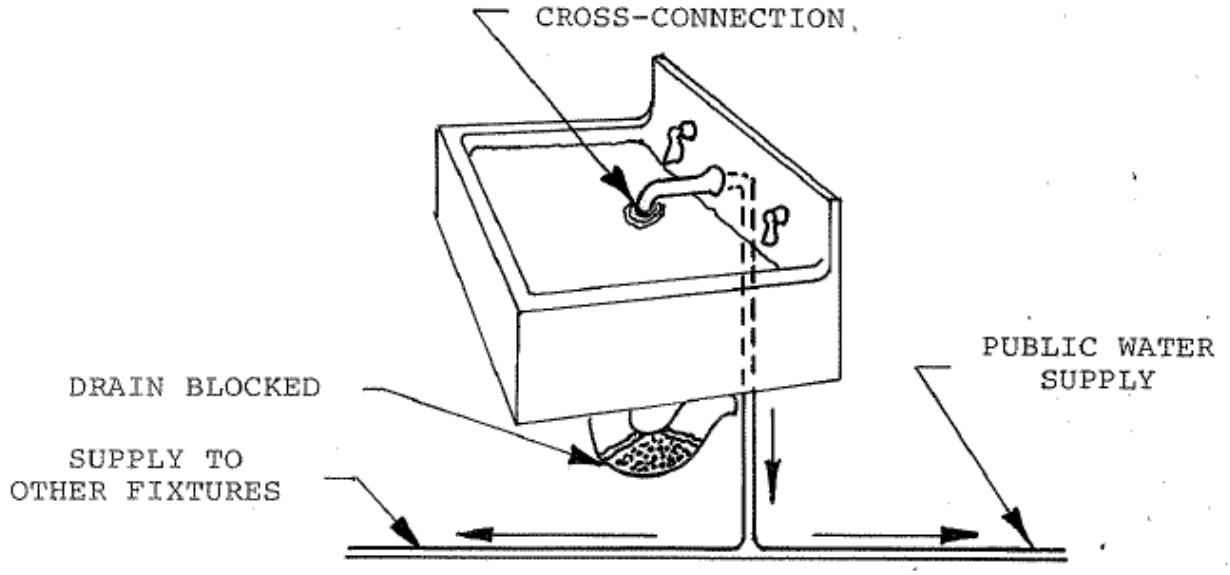


Figure 8. Submerged water supply inlet at sink.

This is also true for the old style bathtubs, which have the fill spout below the flood level rim of the tub. Figure 9 illustrates a situation where a car runs into and breaks off a fire hydrant causing a sudden loss of water and a low or negative pressure in the main line, thus making it possible for contaminated water to backsiphon from the tub into the public water supply.

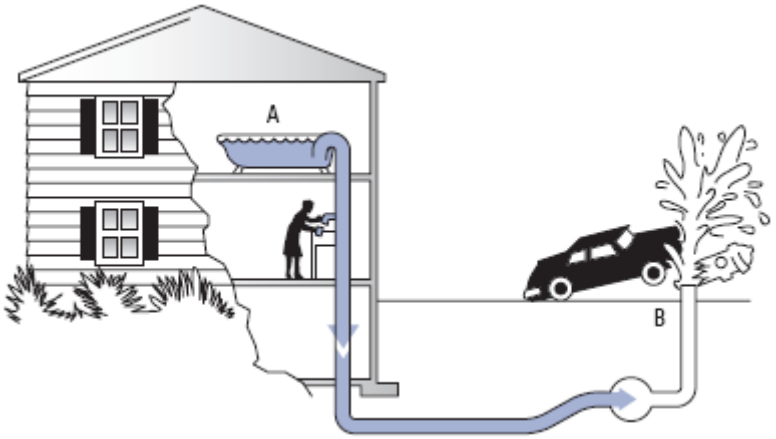


Figure 9. Submerged inlet at tub.

In Figure 10, a chemical mixing tank has a submerged inlet, which may allow backsiphonage during an emergency. A plant fire could reduce the pressure in the public water system and allow the liquid in tank “A” to enter the public and plant water system.

Every water fixture should be designed so that the faucet or fill line is a safe distance above the highest possible water level, providing an air gap, or so that the fill line is protected from backpressure or backsiphonage by an appropriate backflow prevention device. The backflow prevention device should be used only when it is impossible to provide an air gap on the fill line.

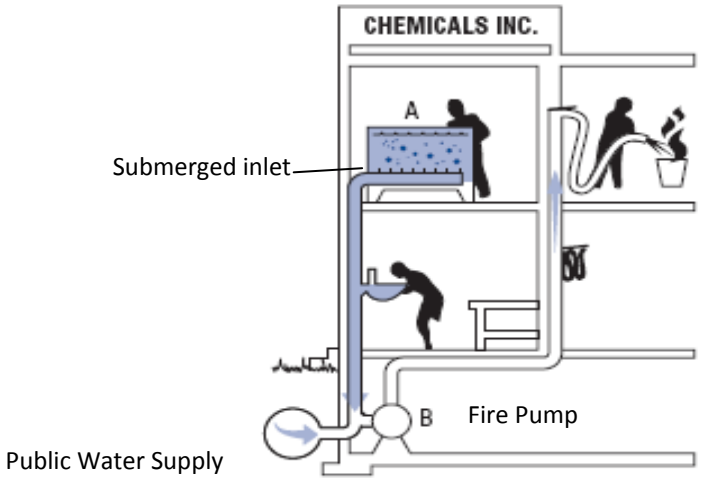


Figure 10. Submerged inlet at chemical mixing tank.

Toilet Bowl (Flush Valve Type)

If there is a blockage in the waste pipe of an old style flush valve type toilet and if a vacuum breaker has not been installed in the supply line, the polluted water will rise above the normal level of the bowl and can be backsiphonaged through the flush valve into the potable water supply (Figure 11).

Toilet Bowl (Tank Type)

A vacuum in the water supply line of some older type-flush tank toilets can backsiphon polluted water from the bowl into the potable or public water system. With stoppage in the bowl, polluted water can rise above the normal level to the flood rim and be backsiphoned into the toilet tank. Then, if the fill supply line is submerged below the normal water level in the tank, a cross-connection is created. A drop in pressure can create a situation that enables tank water to be backsiphoned into the potable water supply if it is not equipped with an anti-siphon ball cock valve (Figure 12).

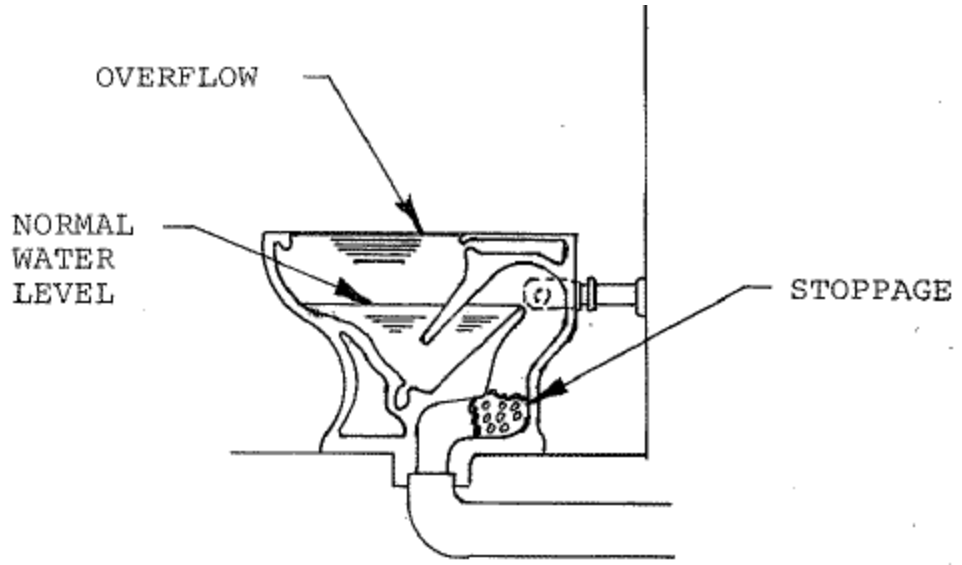


Figure 11. Flush Valve Type

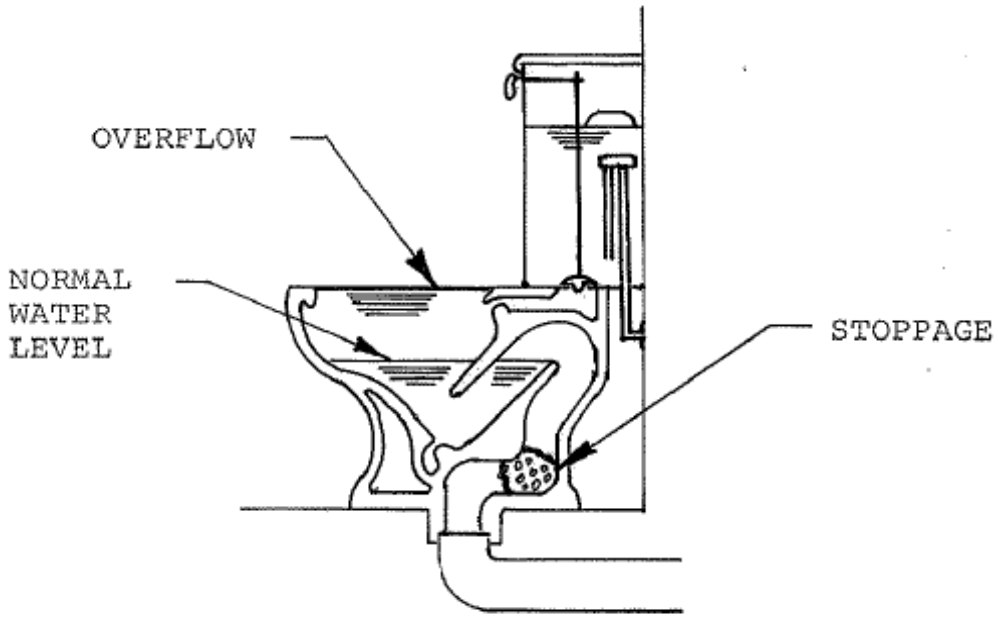


Figure 12. Tank Type

Suction Tee or Aspirator

Vats or containers used in industry are often emptied by means of suction tees, which are operated with the aid of water pressure from the public water system. If a vacuum should occur in the potable water supply line, then the liquid in the vats could be backsiphoned into the potable water supply and then into the public water system. Aspirators are also widely used by the medical profession and in mortuaries (Figures 13A, B and C).

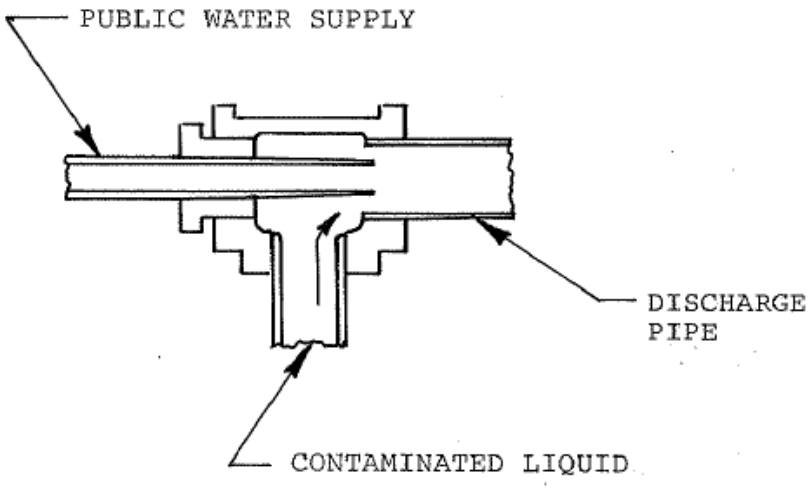


Figure 13A. Suction Tee, Aspirator, or Eductor

Figure 13B. Cleaning fluids diluted and dispersed using water pressure.

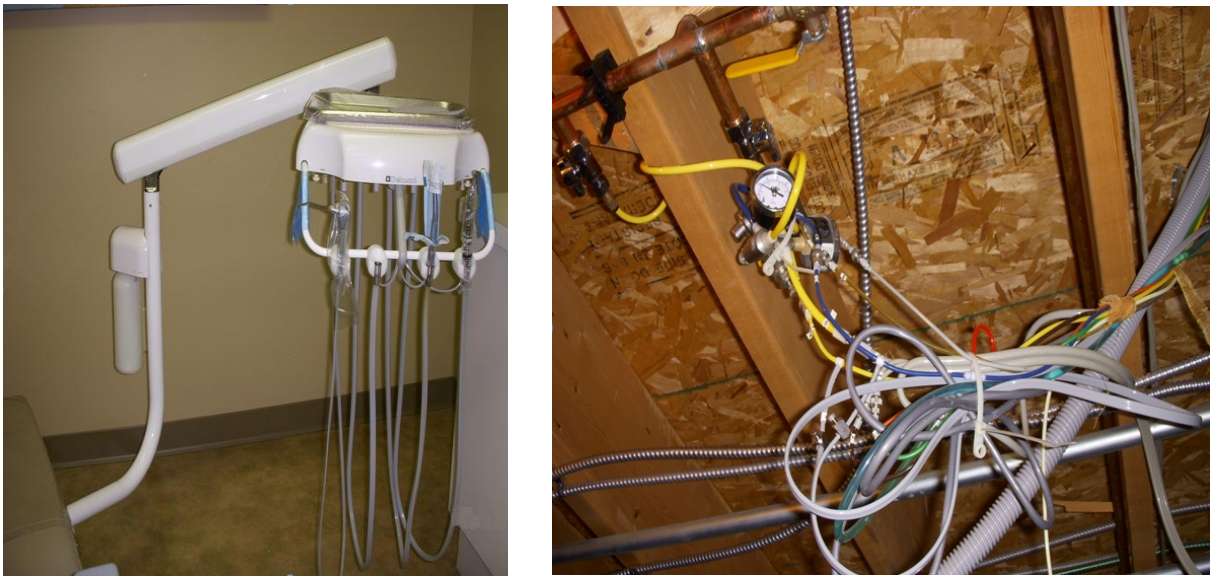


Figure 13C. Type of aspirator at a dental office. Left picture is the aspirator unit and right picture is the tie-in to the water supply plumbing below floor level.

Lawn Sprinklers

Water that has been in contact with fertilizers, herbicides and/or pesticides may pond around the sprinkler heads of an irrigation system and may be drawn back into the potable or public water system (Figure 14).

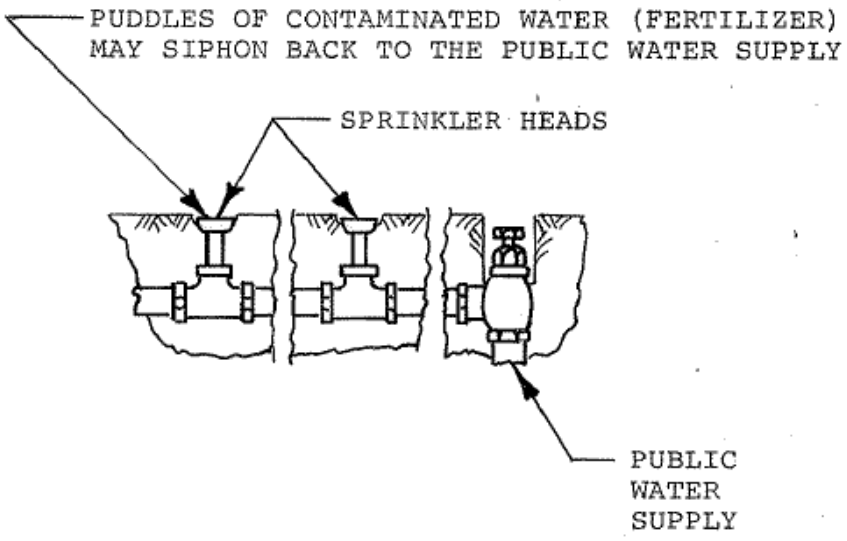


Figure 14. Lawn Sprinklers

Booster Pumps

Backflow may be created by suction on the inlet side of a pump. Tall buildings frequently use the city pressure for the lower floors and a booster pump to fill a gravity or pressure tank for service to the upper floors. If the supply pipe to the building is too small or the city pressure is too low, the pump may create a vacuum on the supply line, causing backsiphoned fluid to be pumped from the lower floors to the upper floors of the building (Figure 15).

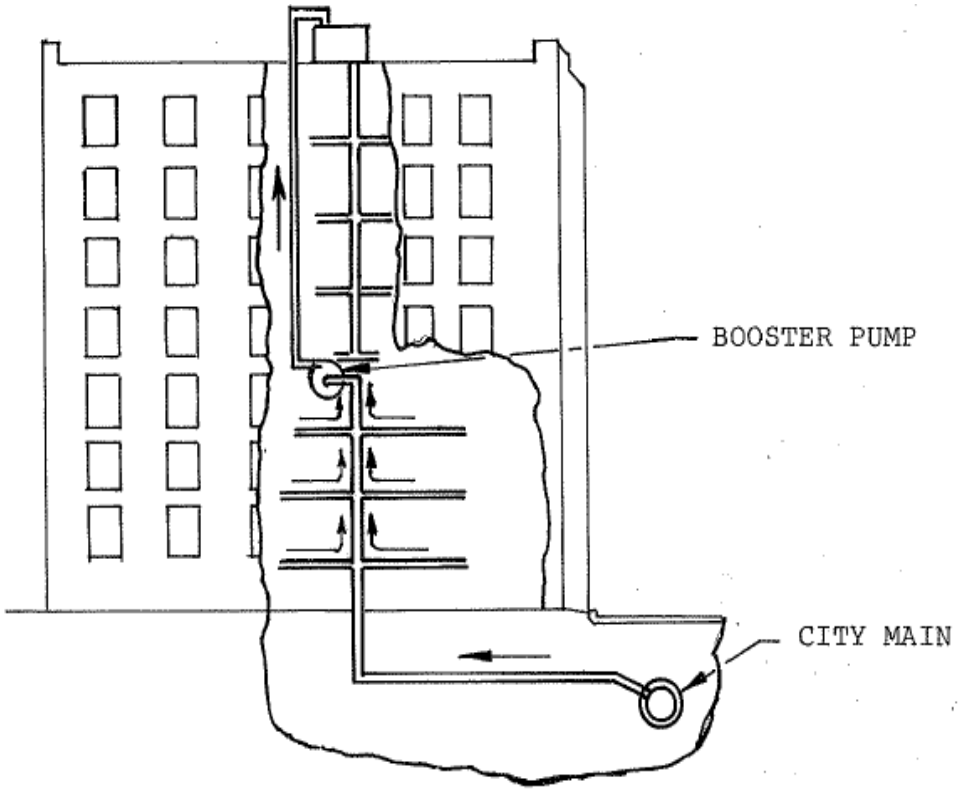


Figure 15. Booster Pump creating backsiphonage due to low suction pressure.

Potential backsiphonage also exists in Figure 16, which shows a booster pump at point “B” in the basement which could reduce the pressure on the suction side of the pump to a level such that the liquid in the dishwater located on the second floor could siphon back into the potable water supply and then into the public water system.

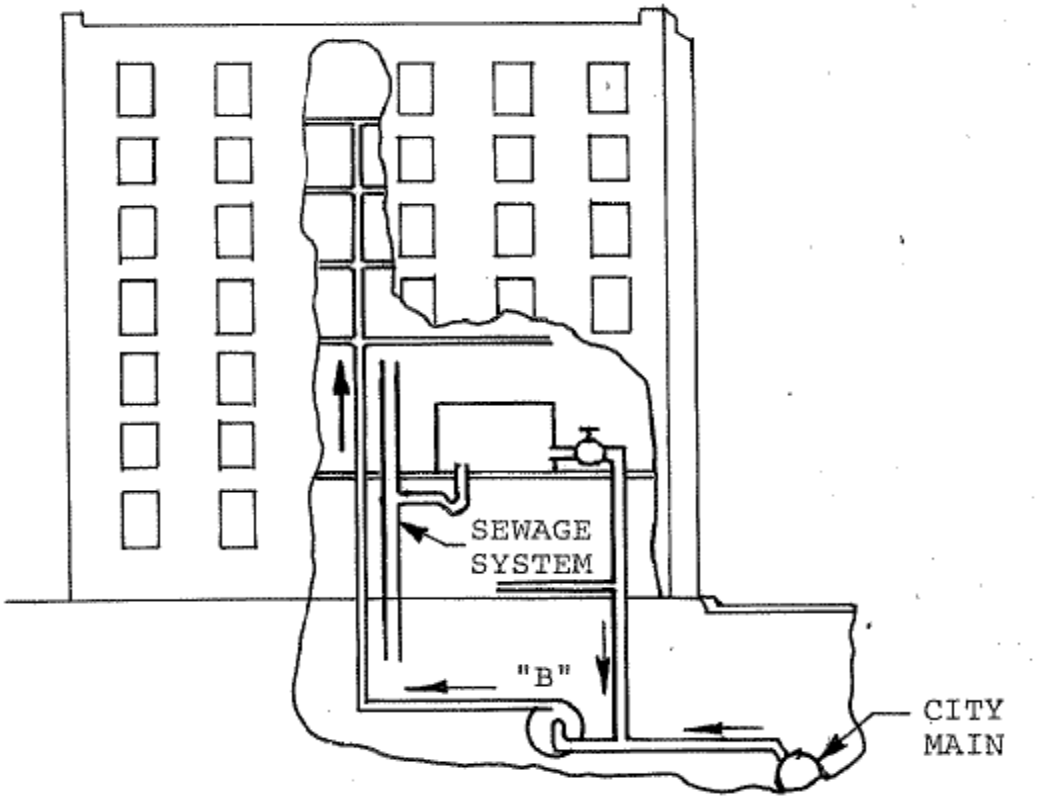


Figure 16. Booster pump creating low suction pressure and backsiphonage of upstream fixture.

In Figure 17, two adjacent multi-story buildings are connected to the same water main, which under high demand conditions lacks adequate pressure. The one building has installed a booster pump. When the pressure is inadequate in the main, the building's booster pump starts pumping which produces a low pressure in the main and causes a reversal of flow in the adjacent building. Again, any cross-connected fixtures can backsiphon into lower floors and possibly into the city main.

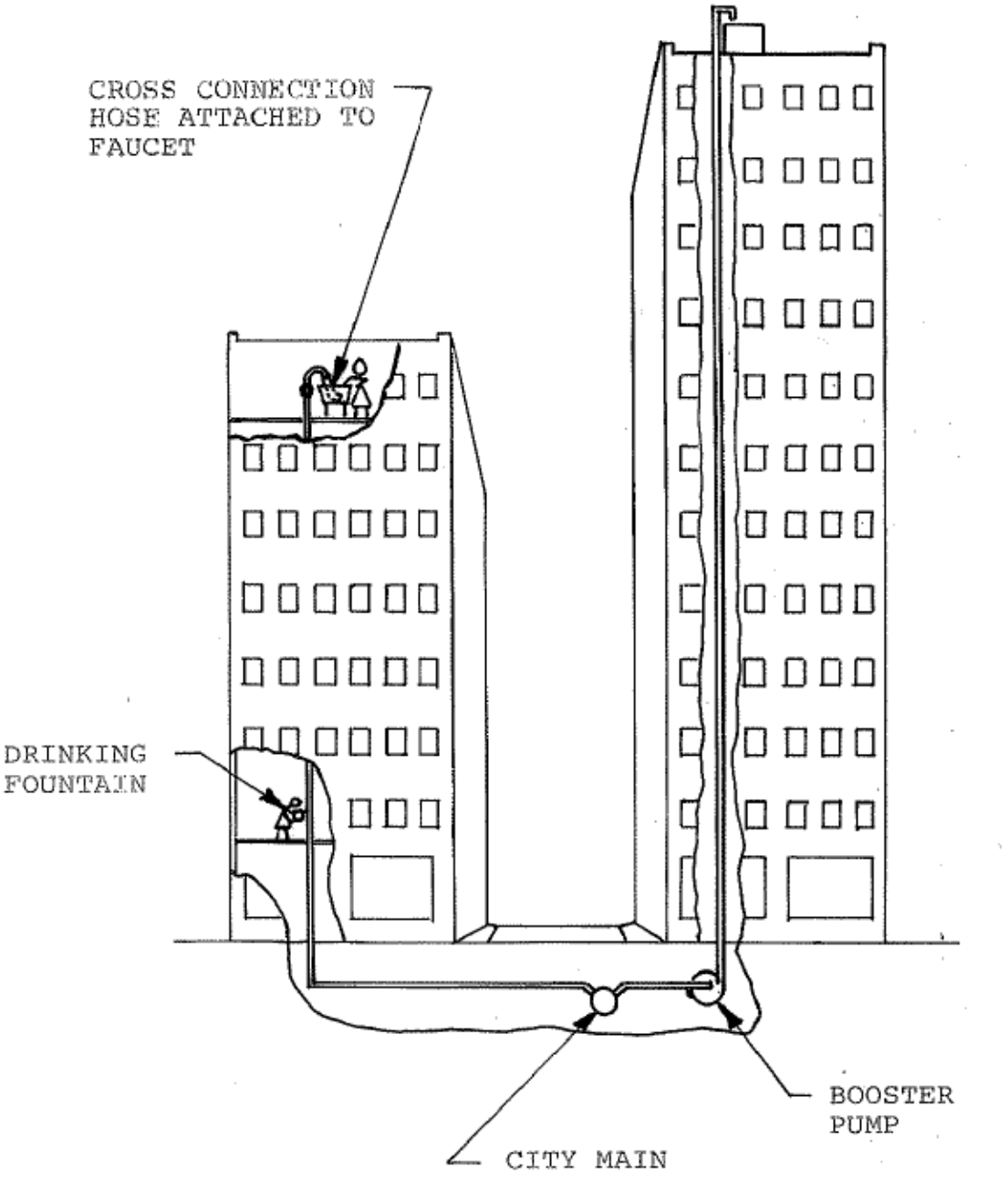


Figure 17. Backsiphonage due to booster pump creating low pressure in service main

To address the hazard associated with backflow of unwanted fluids or gases into the potable water supply through cross-connections, both within consumers' plumbing and the public water systems, a systematic approach must be taken. A cross-connection control program must be implemented to address these hazards. Aside from not creating cross-connections, two methods used to mitigate any hazards are to 'contain' any potential cross-connection hazards to the service connection to protect the public water supply and to 'isolate' cross-connections at individual fixtures to protect the consumer's water supply. Backflow prevention assemblies or devices are used to provide containment or isolation.

CONTAINMENT

The installation of an approved backflow prevention assembly on the consumer's service connection to protect the public water system from possible contamination is known as containment. Experience has shown that it is physically and economically difficult to locate and eliminate permanently all cross-connections within many consumers' water systems. For an outsider to make a thorough and complete survey of piping within the larger and more complicated industrial plants is almost impossible. Many cross-connections are hidden within various kinds of water-using equipment, in walls, underground or in other out-of-sight places where they may not be detected. In some instances, hoses or other temporary connections may be submerged in a hazardous material only for short periods of time and be missed during an inspection. Piping systems in industrial plants are constantly being revised as new products and production methods are developed. Piping or equipment changes are frequently made, usually without authorized inspection, and may result in the creation of new cross-connections.

Therefore, in addition to an effective inspection program for new plumbing installations, bolstered by periodic surveys to address any changes in water use practices, an additional defense is needed to protect contaminants from backflowing into the public water system. This may be accomplished by a procedure known as "control by containment" which involves the installation of a backflow prevention assembly on the consumer's supply line. Such an installation may be required by the supplier of water when, in the opinion of the supplier of water, additional protection to the public water supply system is required. Certain types of facilities are required by rule to install such containment backflow prevention assemblies on the service connection. The use of such an assembly does not eliminate the requirements for individual fixture devices or "air gaps" which isolate the cross-connection at the possible source of contamination or the consumer's responsibility to prevent the installation of illegal cross-connections. An evaluation of water use practices at a facility, as well as the isolation devices in place, are integral in determining the level of protection and type of backflow preventer necessary for containment purposes.

While the installation of a backflow prevention assembly on the consumer's service line will protect the public water system, it will not protect those persons within the plant or building who drink the water. To protect those persons within the plant or building, the containment concept can be utilized within the consumer's water system by isolating portions of the plumbing. The consumer may install a backflow prevention device on the water line leading to those portions of his/her plant or building where there are actual or potential hazards to the potable water supply. In some large plants, devices might be installed on several such branches. The concept of containment within a plant or building is very important since, in a large installation, several thousand people might be employed. Installation of a device to address a cross-connection at the point of possible contamination within the plumbing is referred to as an isolation device.

The following section explains the roles and responsibilities of the parties involved. It also provides the framework of the rules and regulations that apply for backflow prevention and cross-connection control from the water treatment plant to the consumer's tap.

SECTION 3 – BACKFLOW PREVENTION AND CROSS-CONNECTION CONTROL PROGRAM

OBJECTIVE AND AUTHORITY

Backflow and cross-connections in plumbing systems and public water supplies are public health problems that can only be controlled by the implementation of an effective, aggressive, and continuous backflow prevention and cross-connection control program.

A backflow prevention and cross-connection control program requires the full cooperation of the supplier of water, the water consumer, the plumbing and health inspection authorities and the other regulatory agencies. Each shares, to some degree, the responsibility for protecting the health and safety of individuals and the public from the hazards of contaminated water.

All public water supply systems, large and small, shall have a backflow prevention program. This program must include the following segments:

1. An initial survey and inventory of hazards at existing installations.

2. The inspection of new installations for hazards.

3. Installation of backflow preventers acceptable for the degree of hazard identified.

4. Periodic surveys and re-inspections to detect new hazards and to verify improvements or the lack of improvement.

5. A maintenance and testing program for backflow prevention assemblies/devices.

6. An enforcement program to see that hazards are eliminated.

7. Records. Surveys and inventory of hazards, backflow preventer installations and test results must be maintained by the consumer and the supplier of water.

The program should also have:

1. Locally applied modern plumbing code and regulations pertaining to cross-connections.

2. A means for the education of waterworks personnel and others to create an awareness of the problem and competency in the detection and evaluation of health hazards.

The backflow prevention program should have the following objectives:

1. To protect the public water supply from the possibility of contamination by isolating within the consumer's premises contaminants or pollutants which could backflow into the public water system.

2. To eliminate or control cross-connections, actual or potential, between the consumers' in-plant potable water system and any non-potable water systems, plumbing fixtures or industrial piping systems.

3. To provide means whereby a consumer may be able to use an auxiliary water supply for essential industrial or fire protection purposes without the danger of contaminating the public potable water supply.

4. To provide for a continuing program that will systematically and effectively control actual or potential cross-connections that may be established in the future.

RESPONSIBILITY

The responsibility for backflow prevention and cross-connection control rests jointly with the supplier of water, the water consumer, and the regulatory agencies. The regulatory agencies may include the Ohio Environmental Protection Agency, the Ohio Department of Commerce, the local health department, and the certified local building departments. Each has specific responsibilities and each must carry out its phase of a coordinated program in order to obtain cross-connection control.

Backflow prevention and cross-connection control may be divided into two areas of protection. One is backflow prevention for the protection of the public water system, which is the responsibility of the supplier of water. The other is cross-connection control for the protection of the consumer's potable water system, which is the responsibility of the customer-owner of the premises. The regulatory agencies have the basic responsibility of promulgating and enforcing laws and regulations for the protection of both the public water system and the consumer's water system.

The Supplier of Water

The supplier of water has the primary responsibility for providing the consumer with a safe and potable water supply. This responsibility begins at the source, includes all of the public water distribution system and service connections, and ends at the point of delivery to the consumer, which is typically at the meter (including any required backflow preventer). In the exercise of this responsibility, the supplier of water must use reasonable care and vigilance to protect the public water system from hazards originating on the consumer's premises that could contaminate the water in the public potable water system.

The supplier of water may be liable for any failure to take reasonable precautions to protect the public water system from hazards of cross-connections even though located on a consumer's premises. The courts have several times refused to sustain the position that the governmental status of municipalities and municipal officials carries any immunity against liability for negligence in safeguarding the public health. On the contrary, a municipality that operates a water supply system has been held by the courts to have the same rights and be subject to the same liabilities as privately owned utilities with respect to damages due to impurities of the water supply.

The responsibilities of the supplier of water in a backflow prevention program may be divided into four functions:

1. The supplier of water must conduct or cause to be conducted periodic surveys of the consumer's water system to determine the degree of hazard to the public water system.

2. The supplier of water must determine the degree of hazard to the public water system for new water service installations. This can be achieved by review of all plans for new installations prior to their construction to determine the degree of hazard to the public water system and by performance of site inspections during construction or immediately thereafter.

3. When the supplier of water finds that there are uncontrolled cross-connections on the premises or that the consumer is operating his/her system in a manner that could adversely affect the public water system, the supplier of water must require the consumer to eliminate the hazard or to adequately protect the public water system against possible backflow by the installation of suitable containment backflow prevention assemblies at each service connection to the premises.

4. The supplier of water is responsible for requiring the consumer to prove that the backflow prevention assemblies are maintained by the water consumer in proper working order.

<u>The Water Consumer</u>

The water consumer has the dual responsibility of protecting the water users on his/her own premises and of protecting the quality of water in the public water system from contamination originating from conditions on his/her premises. This responsibility begins at the point of delivery to the premises and includes the entire consumer's water system.

To fulfill this responsibility, the water consumer must use reasonable care and vigilance to protect the public water system and consumer's water supply from contamination originating on the premises.

The water consumer is liable for any installation on his/her premises that could endanger the quality of the public or consumer's water supply. The consumer may supposedly use the water as he/she sees fit on his property, but he/she has no right to maintain any condition that could permit contamination to backflow into his/her own water supply or to reach the public water system through service connections to his/her property.

The responsibilities of the water consumer in a backflow prevention and cross-connection control program may be divided into five functions:

1. The water consumer should conduct or cause to be conducted periodic surveys of the water system on his/her premises to determine if there are cross-connections, actual or potential.

2. The water consumer should study all plans for new piping installations to determine the degree of hazard to the potable water supply and should inspect the completed piping installations to insure that the system is free of cross-connections.

3. When the water consumer finds that, there are cross-connections on the premises or that the consumer's water system is being operated in a manner that could adversely affect the consumer's water supply, he/she should either eliminate the hazards or adequately protect the potable water system against backflow by the installation of backflow prevention isolation devices or containment assemblies.

4. The water consumer should protect the consumer's potable water system by compliance with plumbing regulations.

5. The water consumer is responsible for maintaining all backflow prevention assemblies in proper working order and for reporting to the supplier of water the tests and maintenance performed.

The Regulatory Agencies

The regulatory agencies are responsible for enforcing laws, rules and regulations on backflow prevention and cross-connection control. This responsibility is exercised by:

1. Establishing laws, rules and regulations for the protection of the public water system and the consumer's potable water system from the hazards of cross-connections;

2. Requiring plans for new or altered plumbing installations and public water supply systems to be submitted;

3. Inspecting plumbing installations and public water supply systems to determine compliance with state and local laws, rules, and regulations; and

4. Requiring the supplier of water and the water consumer to establish an effective backflow prevention and cross-connection control program.

In the State of Ohio, backflow prevention and cross-connection control is a divided responsibility. No single agency has complete authority or responsibility from the source to the sewer. The State regulatory agencies involved in backflow prevention and cross-connection control are the Ohio Department of Commerce and the Ohio Environmental Protection Agency.

- Housed within the Ohio Department of Commerce, the Ohio Board of Building Standards (OBBS) is responsible for formulating and adopting rules governing the construction, repair, alteration and maintenance of buildings; including plumbing for non-residential and residential buildings. Such rules are applicable throughout the state and cover all dwellings and all public, commercial and industrial buildings. The OBBS is also responsible for the certification of building departments that enforce the plumbing code and for the certification of personnel that work in or for the building departments, including plumbing inspectors. The Department of Commerce's Division of Industrial Compliance, plumbing section, is charged with the responsibility of enforcing the rules adopted by the Ohio Board of Building Standards in state owned buildings and non-residential buildings where there is no certified local building department or local health district enforcing the plumbing code rules adopted by the OBBS. For residential buildings (one-, two-, and three-family dwellings), the OBBS adopted residential plumbing rules are applicable statewide. However, the rules are only enforced in areas where the local government has chosen to pursue certification for its building department to enforce the residential plumbing rules or where there is a local health district enforcing the residential plumbing rules.

  The plumbing enforcement authorities are responsible for inspecting the consumer's water system on the premises to ensure that cross-connections have the appropriate backflow prevention. They inspect the consumer's potable water system, share the liability with the owner, and building design professional in the protection of the internal water distribution system. The plumbing inspection authorities inspect all new construction and review plans for plumbing permits to ensure that no new cross-connections are installed without the appropriate protection.

- The Ohio Environmental Protection Agency has the responsibility for both adopting rules regarding public water systems and for providing general supervision of public water systems. These rules include cross-connection control and backflow

prevention for the protection of the public water supply. The supplier of water is responsible for ensuring compliance with these rules.

Although the supplier of water may have no direct authority over the consumer's water system, the supplier of water is required to conduct or cause to be conducted surveys and investigations of the consumer's premises to determine if a consumer's water use practices pose a backflow hazard and if cross-connections exist that must be mitigated. In addition to the dwelling, the supplier of water needs to consider water use outside a dwelling, which is still considered part of the consumer's premises. The supplier of water must implement a backflow prevention program to protect the public water supply from contamination. This program includes requiring the consumer to install a backflow preventer when a hazard has been identified and to correct an auxiliary water system cross-connection, in order to receive service from the public water supply.

In general, and usually depending upon the location of the meter, the Ohio Department of Commerce Division of Industrial Compliance plumbing section has authority for plan review and inspection of plumbing systems within the building. The Ohio EPA and the supplier of water have authority up to the water meter or main shutoff inside the building, and over all auxiliary water supplies no matter where they are connected to the consumer's water system.

The following figure 18 provides an illustration depicting typical jurisdictional boundaries. The local building department, local health department or Ohio Department of Commerce's Plumbing Section use the isolation principle of backflow prevention to protect the consumer's water system. The water supplier uses the containment principle of backflow prevention to protect the public water supply from backflow.

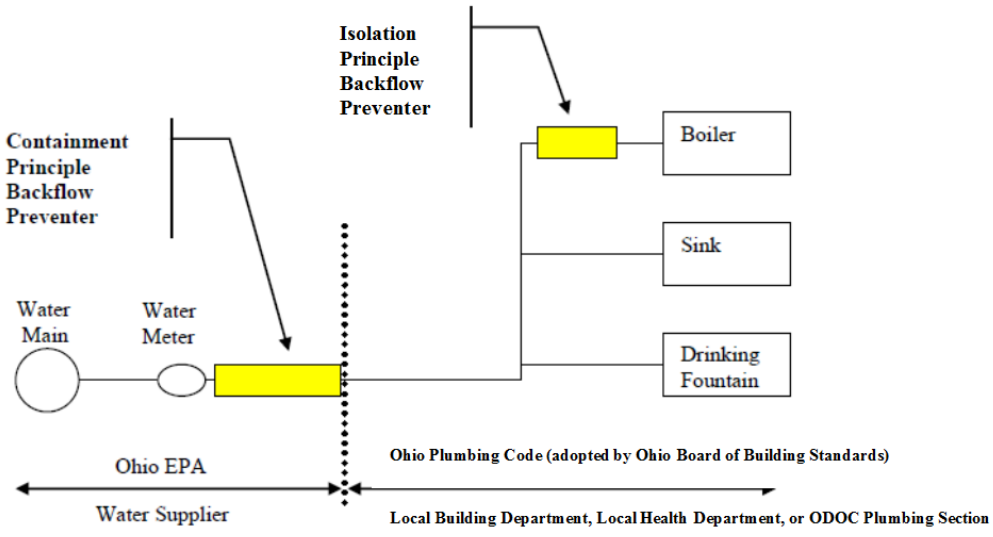


Figure 18. Typical jurisdictional boundaries.

LEGAL AUTHORITY

The successful promotion of a backflow prevention and cross-connection control program is dependent upon the legal authority to conduct such a program.

The supplier of water should adopt an ordinance and/or regulations for backflow prevention that will:

1. Prohibit interconnection with private, auxiliary or emergency water supplies unless approved by the supplier of water and the Ohio Environmental Protection Agency;

2. Provide for a program of inspections for cross-connection hazards;

3. Require the installation of backflow prevention assemblies where, in the opinion of the supplier of water or otherwise required, such assemblies are necessary; and

4. Provide penalties for violation.

Local Ordinances and Regulations

In regards to Ohio EPA regulations, a suggested ordinance and suggested regulations on backflow prevention and cross-connection control for adoption by cities and villages is contained in Appendices II and III.

In regards to plumbing regulations, the rules adopted by the OBBS are considered general laws of the state. For nonresidential buildings, the Ohio Plumbing Code (OPC) is considered the state minimum code and is enforceable throughout the state by local building departments, local health departments, or the Division of Industrial Compliance, Plumbing Section. For residential buildings, the Residential Code of Ohio references the OPC and is enforceable by local building departments that chose to have a building department or by local health departments. Local governments do not need to separately adopt the Ohio Plumbing Code (OPC).

State Statutes and Rules

A listing of state laws and state regulations pertaining to backflow prevention and cross-connection control is provided in Appendix I, along with how to access these regulations. This reference is provided for informational purposes and represents effective statutes and rules at the time of issuance of this manual edition. A full listing and copies of current rules and regulations can be obtained by contacting the state agency.

SECTION 4 – BACKFLOW PREVENTERS

Unfortunately, all backflow preventers that are used for the control of backflow are limited in their ability to provide protection from backflow. It is important that the limitations of each backflow preventer be understood since the degree of protection provided will depend on the type of backflow preventer and the maintenance program employed.

There are two types of mechanical backflow preventers to choose from, assemblies and devices. Assemblies are backflow preventers that have test cocks and shut-off valves enabling them to be tested inline. Backflow devices are not designed for field-testing and the standards for assemblies and devices differ.

Ohio EPA requires the use of assemblies to satisfy regulatory requirements. Ohio EPA requires these backflow preventers to be of a type that has been investigated and approved by the supplier of water and that meets the rule requirements. Ohio EPA requires these assemblies to be used for containment purposes. These assemblies are usually installed just beyond the meter to contain any contamination and prevent it from entering into the public water supply distribution system.

The plumbing code rules adopted by the Ohio Board of Building Standards prescribe the type of backflow preventers to be used for isolation purposes within buildings. These backflow preventers act to isolate any contamination to a fixture or portion of plumbing.

Backflow prevention can be approached through the application of the following:

1. Air gap
2. Backflow prevention assemblies
3. Backflow prevention devices
4. Specific valving and/or piping configurations.

AIR GAP SEPARATION

An air gap separation provides a complete physical separation between the potable water system and a non-potable system. The removal of the cross-connection by means of an air gap separation is the preferred means of preventing backflow as long as the air gap has been properly installed and maintained.

Minimum Air Gap

An air gap is measured vertically from the lowest end of a potable water outlet to the flood rim or highest possible water level of the tank or receiving basin into which it discharges.

Where the potable water outlet terminates above the rim of a tank or receiving basin, the minimum air gap must be at least twice the effective opening of the potable water outlet or one inch, whichever is greater, and at least the minimum distance shown in Table 1. Effective opening refers to the actual opening size at the discharge location. If not round, the diameter is determined by taking the minimum cross-sectional area at the point of potable water supply discharge and expressing it in terms of the diameter of a circle.

Where the potable water outlet is above the spill rim but adjacent to a sidewall, the minimum air gap shall be as indicated in Table 1, which should represent the Ohio plumbing code requirement.

TABLE 1. Minimum Air Gaps For Potable Water Outlets

Outlet Size	Minimum Air Gap	
	When not Affected By Near Wall (*) (Inches)	When Affected By Near Wall (**) (Inches)
Lavatories with effective openings not greater than 1/2 inch diameter	1.0	1.5
Sinks, laundry trays, and gooseneck bath faucets with effective openings not greater than 3/4 inch diameter	1.5	2.25
Over-rim bath fillers with effective openings not greater than 1 inch diameter	2.0	3.0
Effective openings greater than ½ inch	2X Diameter of effective openings	3X Diameter of effective openings

* Side walls, ribs or similar obstructions do not affect air gaps when spaced from inside edge of spout opening a distance greater than three times the diameter of the effective opening for a single wall, or a distance greater than four times the diameter of the effective opening for two intersecting walls.

** Vertical walls, ribs, or similar obstructions extending from the water surface to or above the horizontal plane of the spout opening require a greater air gap when spaced closer to the nearest inside edge of spout opening than specified in (*) above. The effect of three or more such vertical walls or ribs has not been determined. In such cases, the air gap shall be measured from the top of the wall.

Figure 19A illustrates the termination of the potable water outlet above the rim of the receiving basin and Figure 19B illustrates an air gap for a fixture with an adjacent or near wall that could affect the height from which the water can be drawn. Figure 20 shows an air gap application for a process water line to chemical tank for dilution.

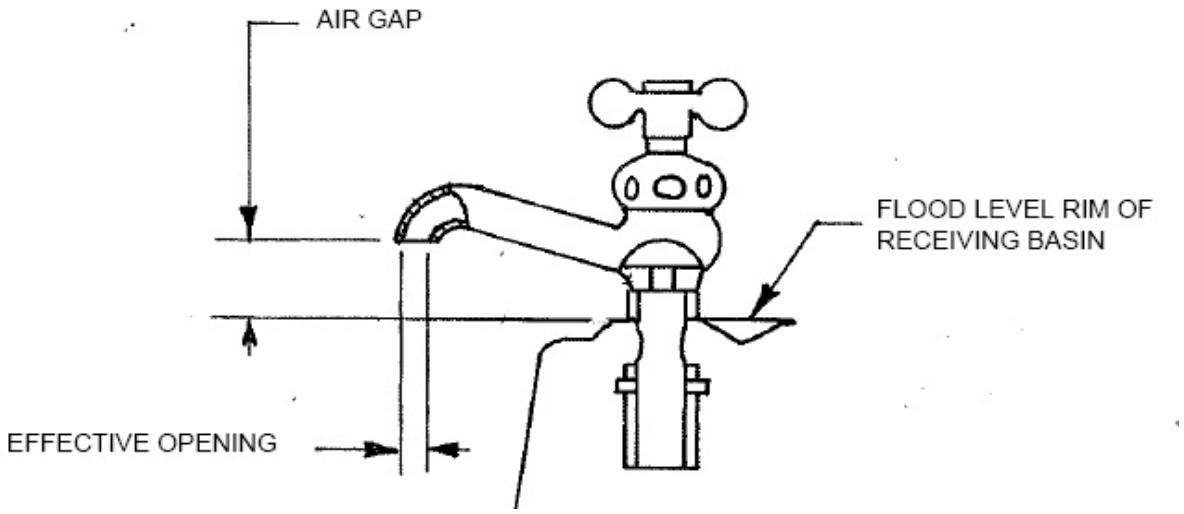


Figure 19A. Air gap and effective opening

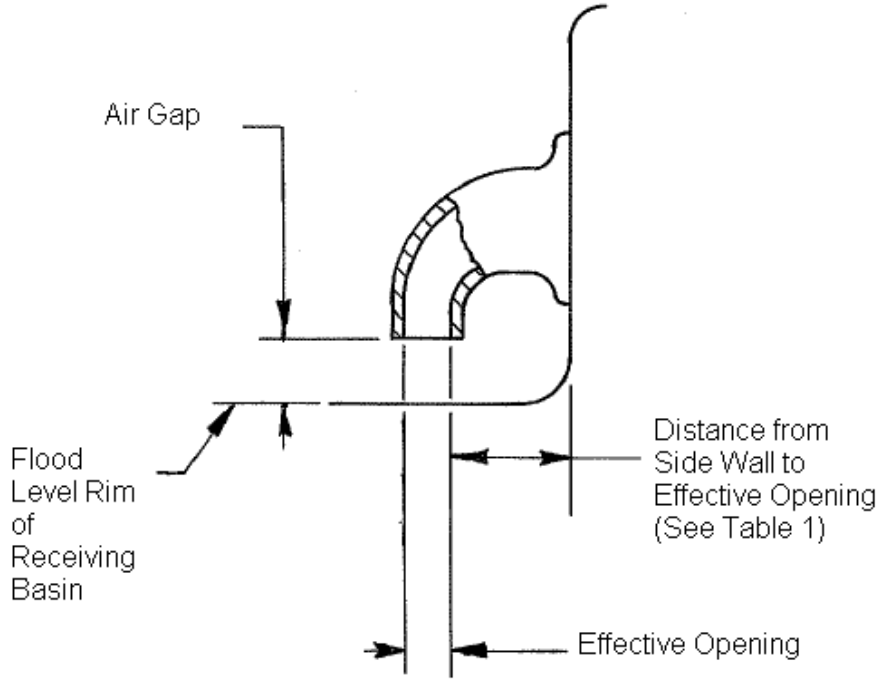


Figure 19B. "Near wall" influence on air gap

Figure 20. Process water fill line to chemical tank with appropriate air gap.

Maintenance and Inspection

Periodic inspections of all air gaps must be made to ensure that they have not been removed or made ineffective by modifications. Ohio EPA, under OAC Rule 3745-95-06(C)(3), requires that an air gap be inspected at least every 12 months.

Advantages

Properly designed and installed air gap separations provide the maximum degree of protection against backflow.

Limitations

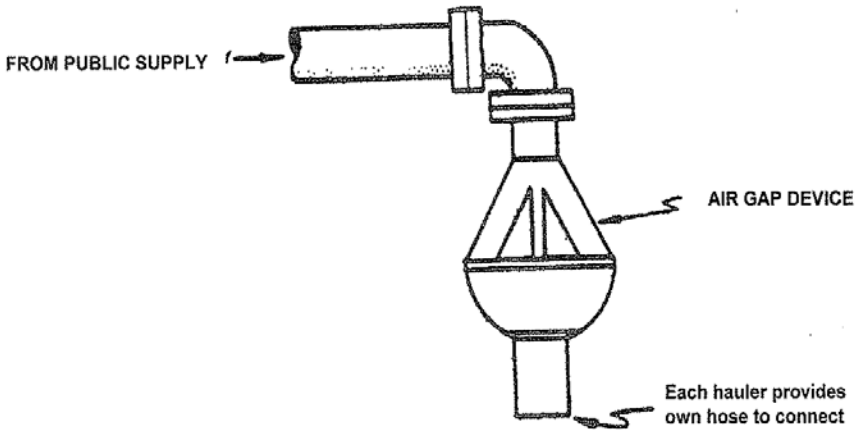
Air gap separations can be defeated by the thoughtless addition of a hose that in effect extends the discharge end of the pipe to a point below the possible high water level of the tank or receiving basin.

Under some conditions, the cost of an air gap separation may be high when compared to a mechanical backflow preventer.

An air gap separation deprives the water consumer of the use of the water pressure in the main

Water Loading Station Air Gap Devices

Figure 21 shows two types of air gap devices that are acceptable for use at water loading stations where water hauling tank trucks are filled from the potable water system. It is important that each water hauler provide their own filling hose to prevent cross-contamination among tank trucks. Figures 22A and 22B show an application of an air gap device at a water loading station.



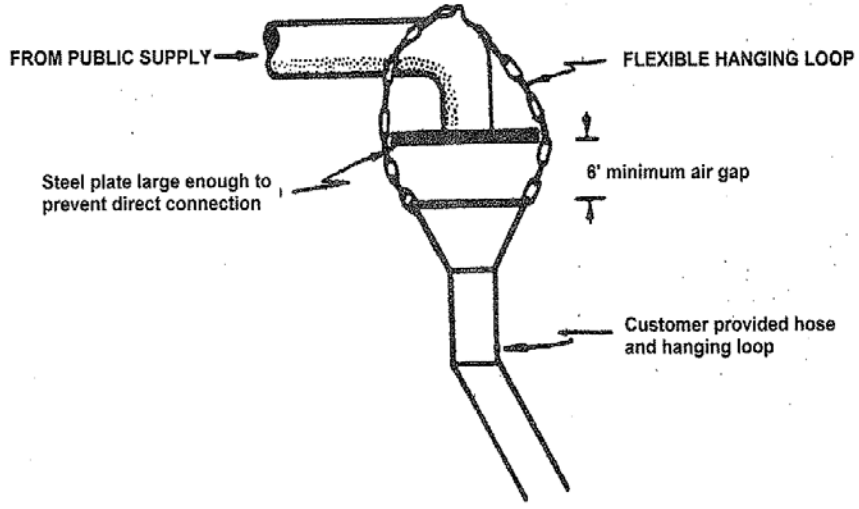


Figure 21. Acceptable water loading station devices
Taken from – Recommended Standards for Water Works, Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (2003).

Figure 22A. Example of acceptable water loading station air gap device.

Figure 22B. Filling line at water loading station. Shared hose connection is discouraged due to risk of cross-contamination.

BACKFLOW PREVENTION ASSEMBLIES

Reduced Pressure Principle Backflow Prevention Assemblies And Reduced Pressure Principle Detector Assemblies

The reduced pressure principle backflow prevention assembly consists of two spring-loaded check valves operating in series, and a spring-loaded/diaphragm-activated differential pressure relief valve located in the zone between the check valves. Two (2) tightly closing shutoff valves and four (4) test cocks complete the assembly. Figure 23 provides a schematic of a reduced pressure principle backflow prevention assembly.
The reduced pressure principle detector assembly is a specially designed assembly composed of a line-size reduced pressure principle backflow prevention assembly with a specific bypass water meter and a meter sized approved reduced pressure principle backflow prevention assembly. The meter registers accurately for low rates of flow and registers for all rates of flow. Figure 24 provides an example of a type of reduced pressure principle detector assembly.

These assemblies will indicate leakage through one or both check valves or the relief valve by the discharge of water from the relief valve port. This factor is an important advantage over the double check valve assembly. The reduced pressure principle detector assemblies are generally used on fire suppression systems. Their specific design warns the user if flow is detected through a fire suppression system. It is a way to monitor use (authorized or unauthorized) or leaks in the system.

Operation

The reduced pressure principle backflow prevention assembly and the reduced pressure principle detector assembly are designed to operate as follows:

- Normal Condition

  Both check valves remain closed until there is a demand for water. In opening and crossing the first check valve, water is reduced in pressure by a predetermined amount by means of the spring loading on the check valve. The differential pressure relief valve remains in a closed position because the inlet pressure is higher than the pressure in the intermediate zone. The second check valve is lightly loaded and remains open as water flows through the assembly in the normal direction.

- Backpressure Condition

  In the event pressure increases downstream of the assembly, tending to reverse the direction of flow, both check valves close to prevent backflow.

  Since any check valve may leak as a result of wear or obstruction, the protection provided by check valves alone is not sufficient where there is a health hazard. If the second check valve is prevented from closing tightly, leakage back into the zone increases the zone pressure to within a few pounds per square inch of the supply pressure; unbalanced pressure on a diaphragm will cause the relief valve to open; and water from the zone is discharged to atmosphere. The diaphragm causes the relief valve to operate automatically to maintain pressure within the zone at a lower pressure than the supply pressure.

- Backsiphonage Condition

  In a backsiphonage condition, when the supply pressure drops, the relief valve opens automatically and drains enough water from the zone to atmosphere to maintain the pressure in the zone at a lower pressure than the supply pressure. Both the first and second check valves will close. The second check valve will close to keep the downstream water from the system from draining through the relief valve.

  If the supply pressure drops below the minimum pressure that is required to close the relief valve, the pressure in the zone will be atmospheric, and the relief valve will remain fully open.

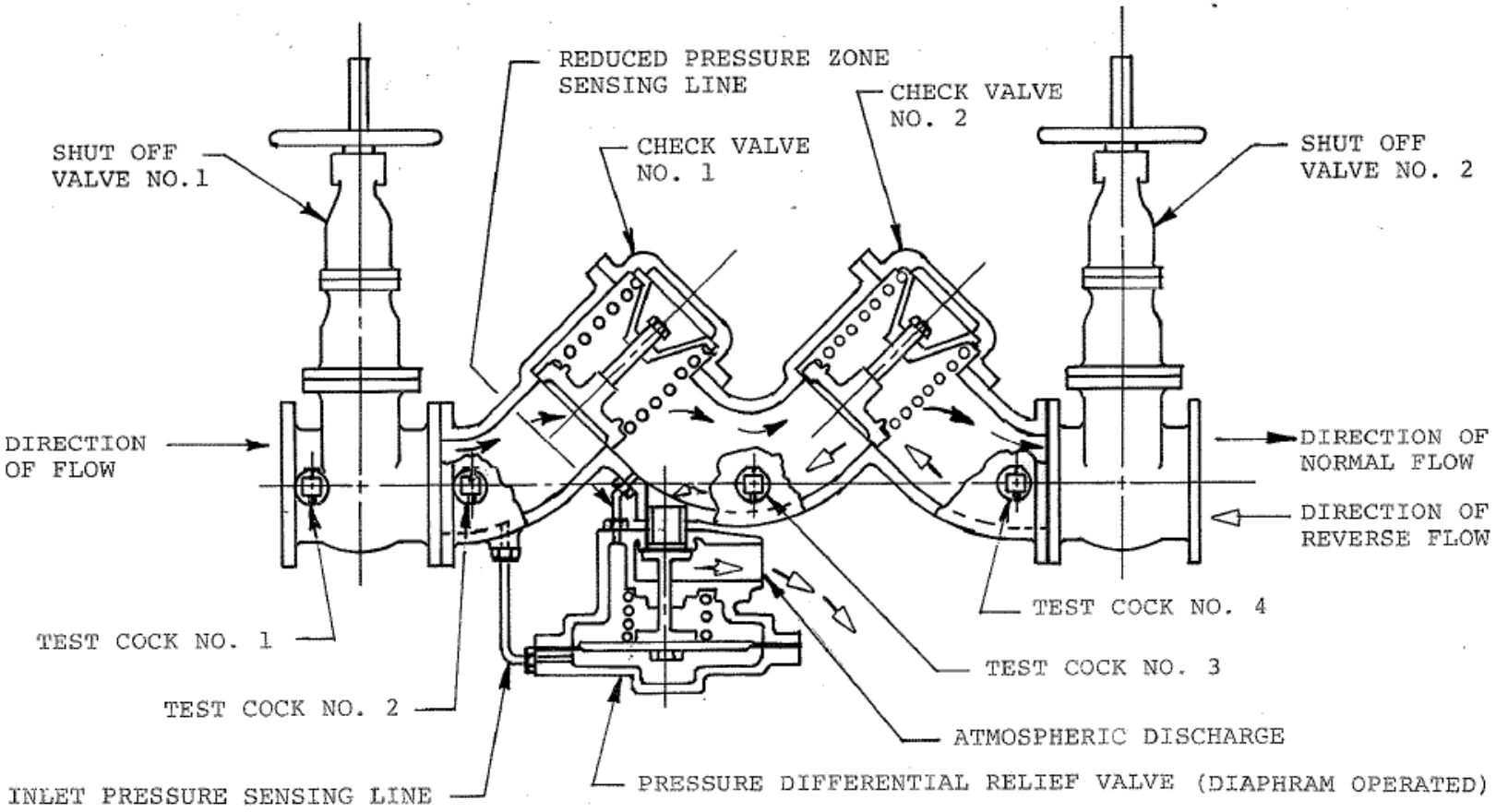


Figure 23 - Reduced Pressure Principle Backflow Prevention Assembly

Figure 24. An example of a reduced pressure principle detector assembly which consists of a full size reduced pressure principle backflow prevention assembly with a bypass line equipped with a meter to register flow and a bypass line-sized RP.

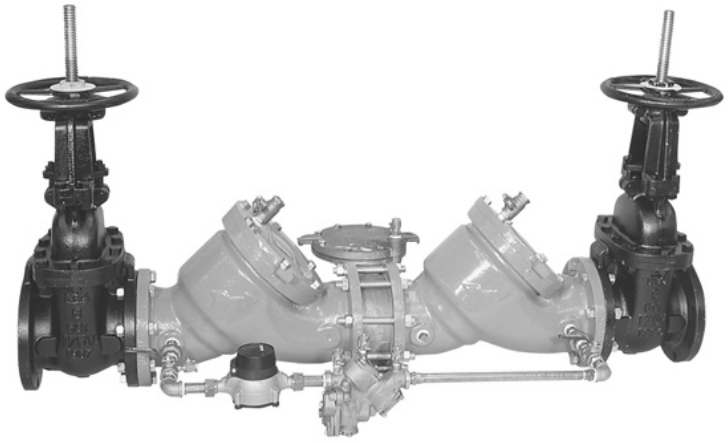


Figure 25. Picture of reduced pressure principle backflow prevention assembly installed in a heated enclosure. The relief valve has an air gap device attachment to prevent direct connection to the relief valve opening.

Design and Construction

The design and construction of approved reduced pressure backflow prevention assemblies that are required to comply with OAC Rule 3745-95, must conform to the requirements of the American National Standards Institute/American Water Works Association standard C511, or American Society of Sanitary Engineering standard 1013, or Canadian Standards Association standard B64.4, or Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California Specifications of Backflow Assemblies for Reduced Pressure Principle Assemblies.

The design and construction of approved reduced pressure principle-detector assemblies must conform to the requirements of the American National Standards Institute/American Society of Sanitary Engineering standard 1047, or Canadian Standards Association standard B64.4.1, or Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California Specifications of Backflow Assemblies for Reduced Pressure Principle-Detector Assemblies - ninth edition .

These assemblies must receive the approval of the supplier of water, as well as meet the rule requirements of the Ohio EPA as outlined above and in OAC Rule 3745-95-06. The referenced edition of these standards in rule must be used to determine if an assembly is acceptable. The suppliers of water may develop a list of assemblies acceptable for use in their public water systems.

If the assembly is installed as an isolation device within the building, it is required to comply with the rules of the OBBS and the referenced standards and editions cited.

Installation Requirements

Reduced pressure principle backflow assemblies and reduced pressure principle-detector assemblies must be:

1. Installed so as to be readily accessible for inspection, testing and maintenance.

2. Provided with adequate space for inspection, testing, maintenance and disassembly.

3. Protected from freezing by installation within a heated building or heated enclosure. Heated enclosures must meet the ASSE 1060 standard. A list of ASSE 1060 Approved enclosures can be found at: *http://www.asse-plumbing.org/Backflow/BackflowResources.htm#ASSE_Approved_Enclosures*

4. Mounted in a horizontal position except for certain models that have been specifically designed to be installed in a vertical position.

5. Installed above ground level or floor level.

6. Installed so that there is a visible free discharge from the relief port with no extension piping.

7. Provided with adequate floor drainage to handle water discharged from the relief port.

The installation of reduced pressure principle backflow prevention assemblies and reduced pressure principle-detector assemblies in pits is specifically prohibited.

Figure 25 provides a picture of an installation of a reduced pressure principle backflow prevention assembly within a heated enclosure.

Maintenance and Inspection

- Routine Inspection – All reduced pressure principle backflow prevention assemblies should be observed regularly for evidence of leakage through the relief valve port.

- Testing Program – Reduced pressure principle backflow prevention assemblies must be tested at regular intervals. The assembly must be tested at the time of installation or repair, and as may be reasonably required by the supplier of water or the Director of Ohio EPA, but in all cases at least once every twelve months. See Appendix V for the test procedure.

  Repairs – Malfunctioning reduced pressure principle backflow prevention assemblies must be repaired immediately or replaced by new or rebuilt units. All repaired or replacement units must be tested using the standard test procedure in Appendix V before they are placed in service. A stock of spare parts should be maintained for repair of malfunctioning units. Since no bypass is allowed and if continuous water service is necessary such as in a hospital or manufacturing process, then parallel assemblies should be installed. This will allow the shutdown of one assembly for test or repair while the remaining assembly is in service.

  Records – A complete record of each reduced pressure principle backflow prevention assembly must be maintained by the consumer and a copy forwarded to the supplier of water. This shall include a record of all tests, inspections and repairs. These records must also be maintained by the supplier of water for at least a rolling five-year period, and recommended, for the life of the unit.

  If the assembly is installed as an isolation device within the building, it is required to comply with the rules of the OBBS. At the time of issuance of this manual, OAC rule 4101:3-3-01 (Section 312.10) also prescribes requirements for testing of backflow prevention assemblies.

Advantages

The reduced pressure principle backflow prevention assembly, when periodically tested and properly maintained, may be used for backflow protection in situations where it would be extremely difficult to provide an air gap separation between two systems.

Malfunctioning of the reduced pressure principle backflow prevention assembly is indicated by a discharge of water from the relief valve port.

Reduced pressure principle backflow prevention assembly provides protection from backflow due to both backpressure and backsiphonage.

Limitations

Reduced pressure principle backflow prevention assemblies are mechanical assemblies that require periodic testing and maintenance.

Pressure loss through reduced pressure principle backflow prevention assemblies may be expected to be between four and twenty pounds per square inch in the manufacturers' suggested range of operation, depending upon the manufacturer's design, the size of the device and the flow rate.

Reduced pressure principle backflow prevention assemblies may not be used in severe health hazard situations where significant morbidity or death could result from the backflow of a contaminant.

Double-Check Valve Assemblies and Double Check-Detector Check Valve Assemblies

A double check valve assembly consists of an assembly of two independently acting check valves mounted between two tightly closing shut-off valves and fitted with four properly located test cocks. Figure 26 provides a schematic of a double check valve assembly. Figure 27 shows a type of double check valve assembly.

A double check-detector check valve assembly consists of a specially designed assembly composed of a line-size approved double check valve assembly with a specific bypass water meter and a meter-sized approved double check valve assembly. The meter registers accurately for only very low rates of flow and shows registration for all rates of flow. These assemblies are generally used on fire suppression systems. Their specific design warns the user if flow is detected through a fire suppression system. It is a way to monitor use (authorized or unauthorized) or leaks in the system. Figure 28 shows an installation of a double check-detector check assembly.

This type of backflow prevention assembly evolved from the use of a single check valve. Years of experience has shown that a single check valve does not afford sufficient reliability in protecting potable water supplies from backflow. The use of two check

valves in series provides more reliable protection against backflow than a single check valve.

The double check valve assembly is very useful, and when properly maintained, reliable means for backflow protection from aesthetically objectionable or degrading materials which are not actually dangerous to health or to the public water system. The assembly has the inherent weakness of failing without giving indication that a failure is occurring.

These assemblies must not be used where protection against backflow is essential for the protection of a severe health, health or system hazards.

Design and Construction

The design and construction of approved double check valve assemblies must conform to the requirements of the American National Standards Institute/American Water Works Association standard C510, or American Society of Sanitary Engineering standard 1015, or Canadian Standards Association standard B64.5, or Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California Specifications of Backflow Assemblies for Double Check Valve Assemblies;

The design and construction of approved double check-detector check valve assemblies must conform to the requirements of the American National Standards Institute/American Society of Sanitary Engineering standard 1048, or Canadian Standards Association standard B64.5.1, or Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California Specifications of Backflow Assemblies for Double Check-Detector Assemblies.

These assemblies must receive the approval of the supplier of water, as well as meet the rule requirements of the Ohio EPA as outlined above and in OAC Rule 3745-95-06. The referenced edition of these standards in rule must be used to determine if an assembly is acceptable. The suppliers of water may develop a list of assemblies acceptable for use in their public water systems.

If the assembly is installed as an isolation device within the building, it is required to comply with the rules of the OBBS and the referenced standards and editions cited.

Installation Requirements

Double check valve assemblies must be located so as to:

1. Permit easy access.

2. Provide adequate space for maintenance, inspection, testing and disassembly.

3. Prevent submergence

4. Be protected from freezing temperatures by installation within a heated building or heated enclosure. Heated enclosures must meet the ASSE 1060 standard. A list of ASSE 1060 Approved enclosures can be found at: *http://www.asse-plumbing.org/Backflow/BackflowResources.htm#ASSE_Approved_Enclosures*

Installation above ground level is preferred. Where above ground installations are not reasonably practical, a pit or vault may be used. The pit or vault must be:

1. Installed to ensure watertight construction.

2. Constructed so that it will not flood. Surrounding grade shall slope away from the pit or vault to drain water away from the area.

3. Designed with a sump if subjected to ground water.

4. Provided with an access ladder and adequate natural or artificial light to permit maintenance, inspecting and testing.

5. Protected against sanitary sewage. Pit drains shall not be connected to a sanitary sewer.

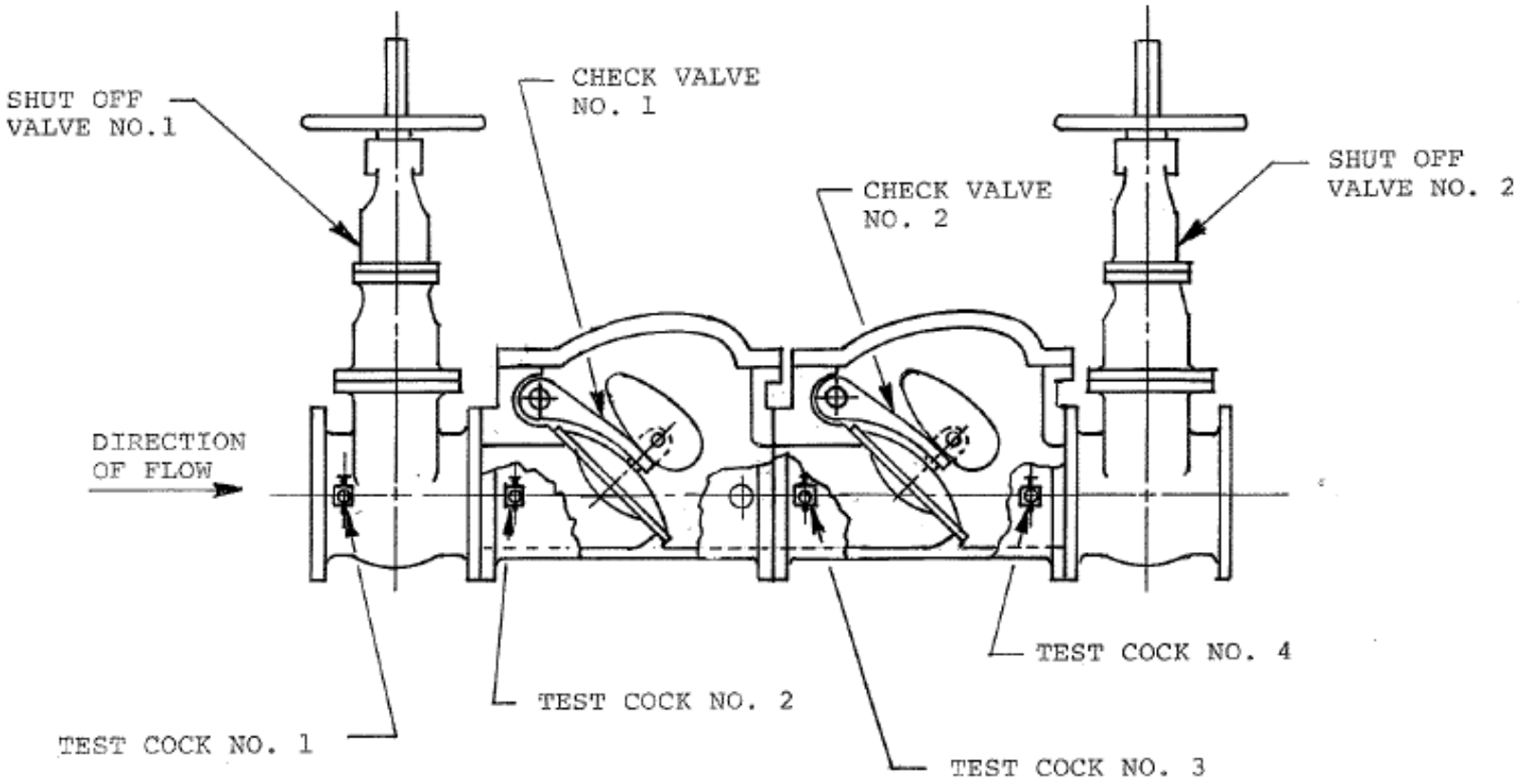


Figure 26 – Schematic of double check valve assembly

Figure 27. An example of a double check valve assembly.

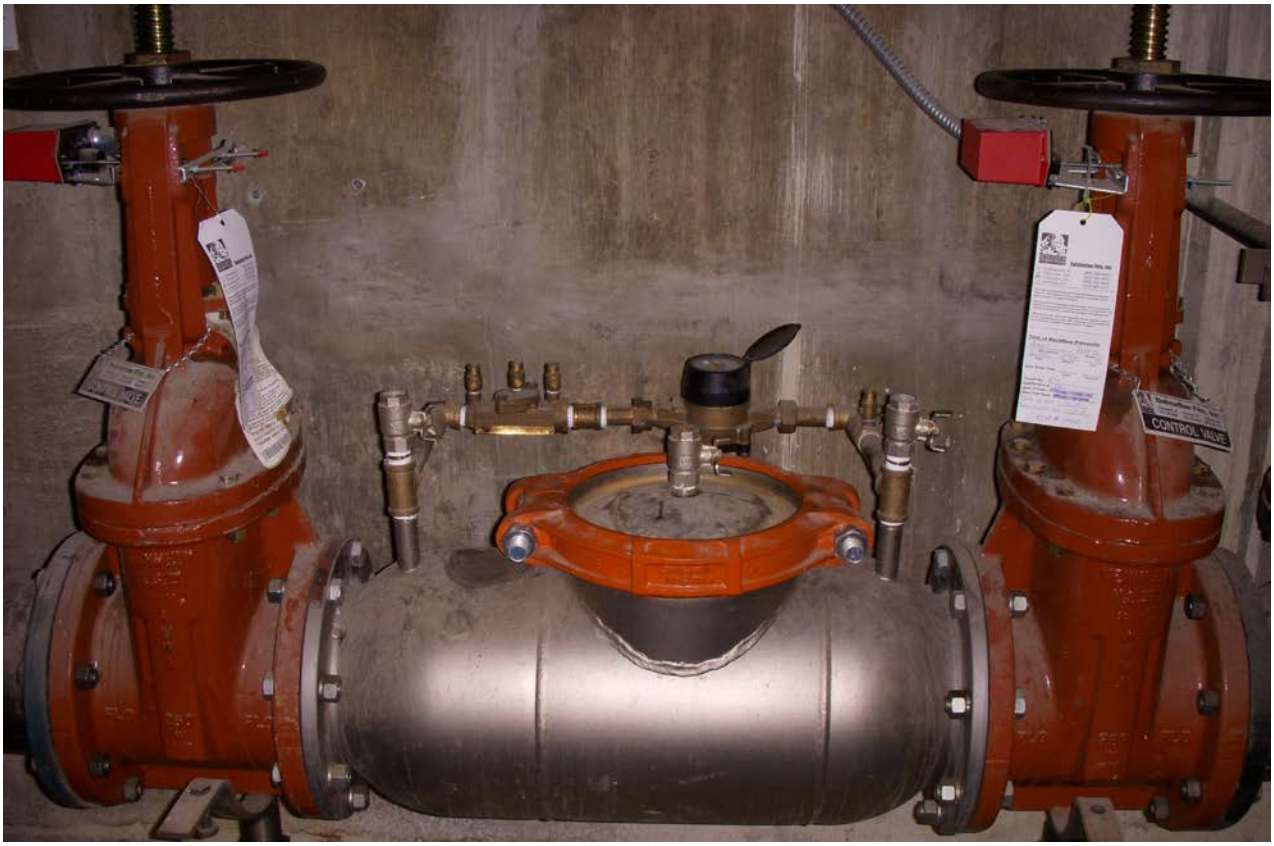


Figure 28. Installation of a double check-detector check assembly

Inspection and Testing Program

Double check valve assemblies must be inspected and tested at regular intervals. The assembly must be tested at the time of installation or repair, and as may be reasonably required by the supplier of water or the Director of Ohio EPA, but in all cases at least once every twelve months.

If leakage through the valves is detected during testing, the assembly must be dismantled, internally inspected and repaired immediately. The field test procedure and internal inspection routine is contained in Appendix V.

If the assembly is installed as an isolation device within the building, it is required to comply with the rules of the OBBS. At the time of issuance of this manual, OAC rule 4101:3-3-01 (Section 312.10) also prescribes requirements for testing of backflow prevention assemblies.

Records

A complete record of each assembly must be maintained by the consumer and a copy forwarded to the supplier of water. This shall include a record of all tests, inspections and repairs. These records must also be maintained by the supplier of water for at least a rolling five year period, and recommended, for the life of the unit.

Advantages

The primary advantage of a double check valve assembly is that when its two check valves are in the wide open position, there is relatively little resistance to flow. The head loss through the assembly ranges between two and ten pounds per square inch, depending on the manufacturer's design, the rate of flow and the diameter of the assembly.

Double check valve assemblies provide protection against backflow due to both backsiphonage and backpressure.

A double check valve assembly may be less expensive to install than an air gap separation or reduced pressure principle backflow prevention assembly.

Limitations

Double check valve assemblies have the inherent weakness of possible failure without giving an external indication that a failure has occurred.

Double check valve assemblies may be used only where there are no severe health, health or system hazards.

BACKFLOW PREVENTION DEVICES

The following paragraphs on backflow prevention devices are provided for informational purposes only. These devices are not recognized to be used for containment at the service connection. Please refer to the Ohio Department of Commerce's *Backflow Prevention and Cross-Connection Control Manual*, or contact the Industrial Compliance, Plumbing Division, Backflow Section for further information and requirements related to devices used for isolation purposes in plumbing systems.

Vacuum Breaker Device

A vacuum breaker is a device or means for preventing backsiphonage by admitting atmospheric pressure to a piping system that is under a vacuum or negative pressure so that a siphon cannot be created. Devices of this nature are commonly identified by several different names such as vacuum breaker, anti-siphon, valve, anti-siphon vacuum breaker, siphon breaker and backsiphonage preventer. Vacuum breakers do not provide protection against backflow resulting from backpressure.

Current practice requires that all vacuum breakers contain two essential parts: an air inlet valve and an upstream check valve. In the past air inlet valves, also known as atmospheric vents, have occasionally been used alone for protection from backsiphonage. This practice is no longer permitted by the Ohio Plumbing Code. These devices may be used alone for such purposes as protecting pressure vessels from collapse during vacuum situations, but not for protection from backsiphonage.

Pressure Vacuum Breaker

A pressure vacuum breaker may be acceptable as an isolation device only. Ohio EPA does not recognize a pressure vacuum breaker as a containment backflow preventer.

Pressure vacuum breakers are assemblies as they contain inlet and outlet shut-off valves and have two appropriately located test cocks for testing purposes. It contains a check valve located downstream of an inlet valve. The check valve is spring loaded and is in a normally closed position. The air inlet valve is also spring loaded and is in a normally open position. During periods of flow, water pressure opens the check valve and closes the air inlet valve. During periods of no flow (depressurization) or backsiphonage conditions, the check valve closes and the air inlet valve opens to introduce air and return the system to atmospheric pressure.

The pressure type vacuum breaker is designed to be installed in a pressurized system with shut-off valves downstream from the device. Under conditions of continuous

pressure for long periods of time, the valve elements would tend to stick closed. The spring loading counteracts this effect.

In a pressure type vacuum breaker, the air inlet valve and the check valve must be independently operating. In some older models of pressure vacuum breakers, only the check valve is spring loaded; in newer models both the air inlet valve and the upstream check valve are spring loaded.

Figure 29 shows the design of a pressure vacuum breaker. These are generally available in sizes 1/2 through 2 inches. Figure 30 provides an illustration of a pressure vacuum breaker installation.

Design and Construction

In accordance with the Ohio Plumbing Code, the design and construction of pressure vacuum breaker assemblies must comply with the American Society of Sanitary Engineering (ASSE) standard 1020 or Canadian Standards Association (CSA) standard B64.1.2.

Installation

Pressure vacuum breakers (PVB) must not be installed where they would be subjected to backpressure such as feeds to boilers, elevated tanks, or pumps. Pressure type vacuum breakers must be installed at least 12 inches above the flood level rim. Pressure vacuum breakers must be installed in an upright position.

PVBs should not be installed in locations where they would be subjected to corrosive fumes that could render the device inoperative.

Figure 31 shows a typical pressure type vacuum breaker installation. Shut-off valves may be installed on the downstream side of pressure vacuum breakers.

Inspection

Pressure vacuum breakers must be periodically inspected to determine if:

1. The device has been removed.

2. The device has been properly installed.

3. The device is operative.

Failure of a pressure vacuum breaker normally occurs as a result of a rupture of the rubber membrane in devices using a rubber check valve or failure of the disc in a disc type device.

Corrosion or build-up of lime deposits on the pressure vacuum breaker seat can cause leakage or sticking of the device.

In addition to a visual inspection, pressure vacuum breakers should be periodically tested, disassembled, and internally inspected.

Advantages

The principle advantages of vacuum breakers are their low cost and their ready availability. They may be subject to continuous pressure, unlike other vacuum breakers.

Limitations

Vacuum breakers do not provide protection against backflow resulting from backpressure.

Vacuum breakers are mechanical devices that require periodic inspection and maintenance.

Application to Public Water Systems

Most residential water-only irrigation systems, without assistance from a tank or pump, are installed with a pressure vacuum breaker on the portion of plumbing supplying the irrigation system. Submerged nozzles on the irrigation system pose a health threat as pooling water or applied fertilizer can be suctioned into the water supply.

When a residential irrigation system supplies water only (without chemical additive), is not subject to backpressure, and is not equipped with a pump or tank or at an elevation which can apply backpressure to the public or consumer's water system, the supplier of water may determine that the PVB is sufficient to abate or control the cross-connection. If a PVB is used to mitigate the hazard posed by the water-only irrigation system, in lieu of a containment assembly, the PVB must:

1. Conform to Ohio EPA's rules 3745-95-05 and 3745-95-06 and Ohio Board of Building Standard's rules and be installed in an upright position and at least 12 inches above the highest nozzle.

2. Be tested at least every 12 months by an individual acceptable to the supplier of water, with test results submitted to the supplier of water. See Appendix V for detailed test instructions.

3. If a PVB is part of a system that is shut-down seasonally, be tested upon start-up of the system each year. The PVB must also be tested if temporarily removed

from service once placed back into service. The PVB must be tested in-situ using potable water supply from the consumer's plumbing.

The above requirements do not take the place of any plumbing code requirement that may apply for an isolation device. This exception does not preclude the purveyor of water from requiring a containment assembly, such as an RP, to be installed (at the meter) when deemed appropriate.

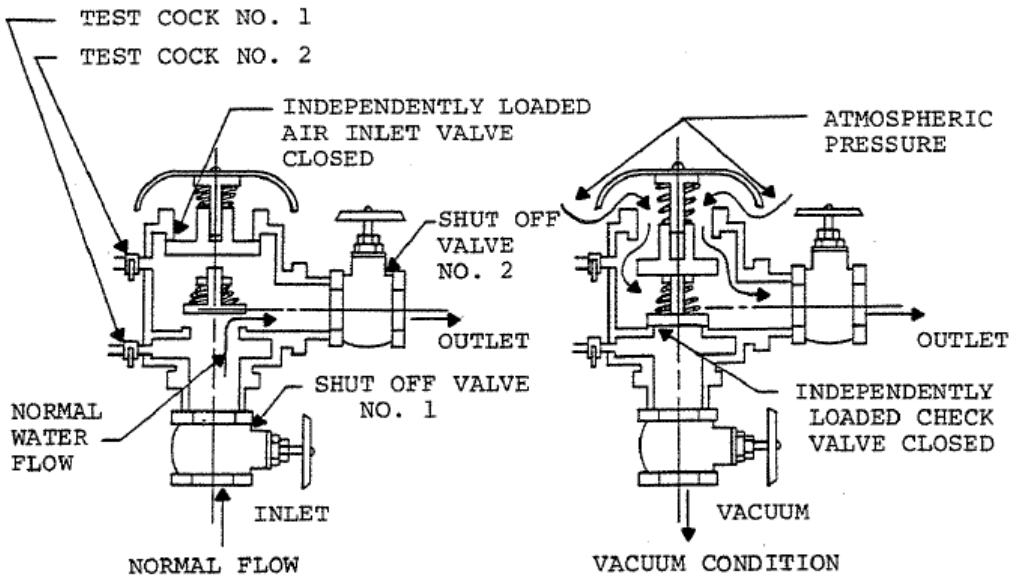


Figure 29. Schematic of pressure vacuum breaker

Figure 30. Example of a pressure vacuum breaker installed

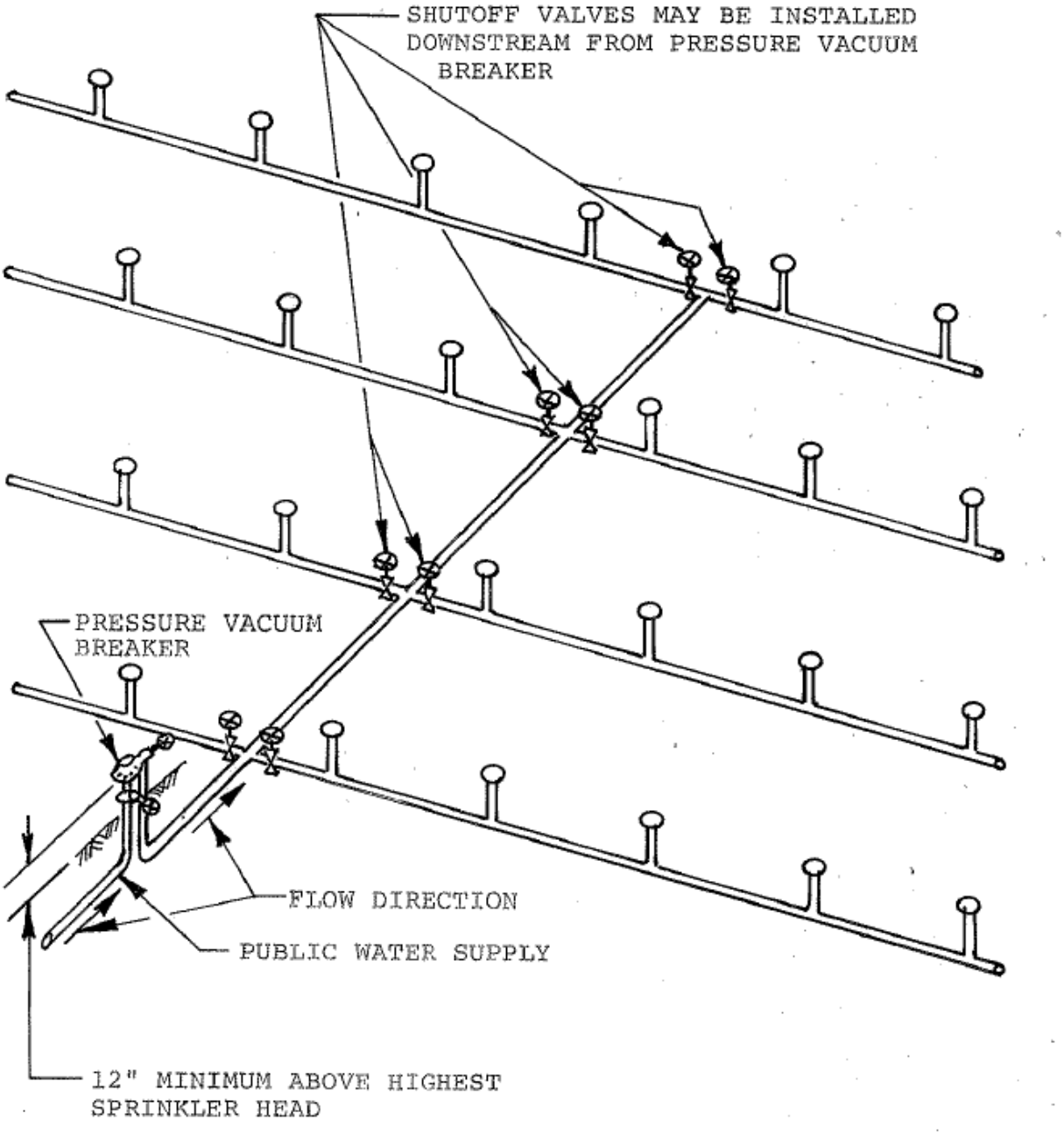


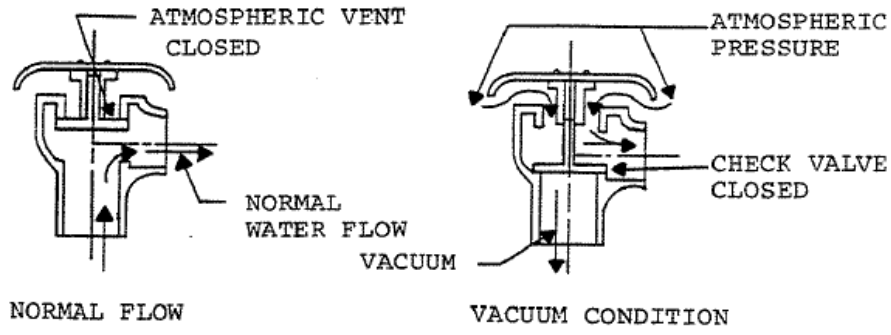
Figure 31. Typical pressure vacuum breaker installation

Atmospheric Vacuum Breaker

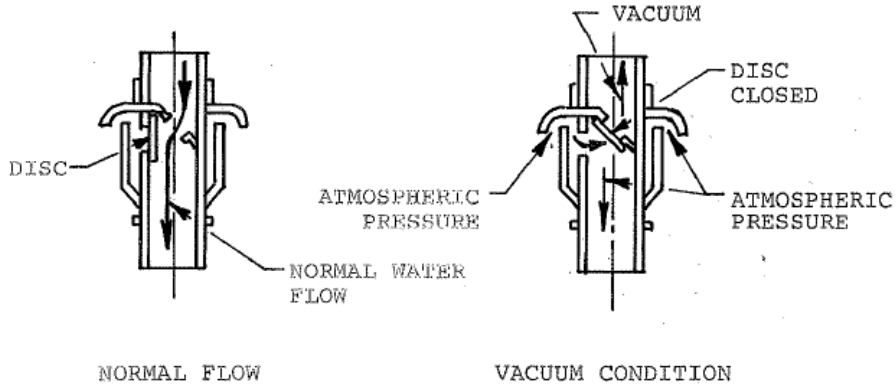
The atmospheric type vacuum breaker, also called the non-pressure type, is the most widely used type of vacuum breaker. It is designed to be installed on the downstream (or atmospheric) side of the last valve in the system and to be operated under pressure not more than twelve hours in any twenty-four hour period.

This unit does not contain springs, but utilizes gravity to actuate the air inlet valve whenever the flow stops or during a backsiphonage situation. In most atmospheric vacuum breakers the air inlet valve and the upstream check valve share a common disc or float as the closing element.

Figure 32 shows the design of an atmospheric vacuum breaker and the principle of operation during a vacuum condition (A) for general use and (B) for use on urinals and water closets. The general use type is typically available in sizes 1/4 inch through 3 inches.



A. GENERAL USE TYPE



B. FOR USE ON URINALS AND WATER CLOSETS

Figure 32. Atmospheric vacuum breaker designs and principle of operation during vacuum condition.

Installation

Atmospheric vacuum breakers must not be installed where they would be subjected to backpressure such as feeds to boilers, elevated tanks, or pumps. Atmospheric type vacuum breakers must be installed at least six inches above the flood level rim of the fixtures or equipment they serve.

Atmospheric vacuum breakers should not be installed in locations where they would be subjected to corrosive fumes that could render the device inoperative.

A shut-off valve must not be installed at any location on the discharge side of an atmospheric type vacuum breaker. The installation of such a valve would allow the valve to be under constant pressure and cause the valve to stick or take a permanent seat that would not allow air to enter through the valve under a vacuum condition.

Figure 33 shows a typical atmospheric type vacuum breaker installation.

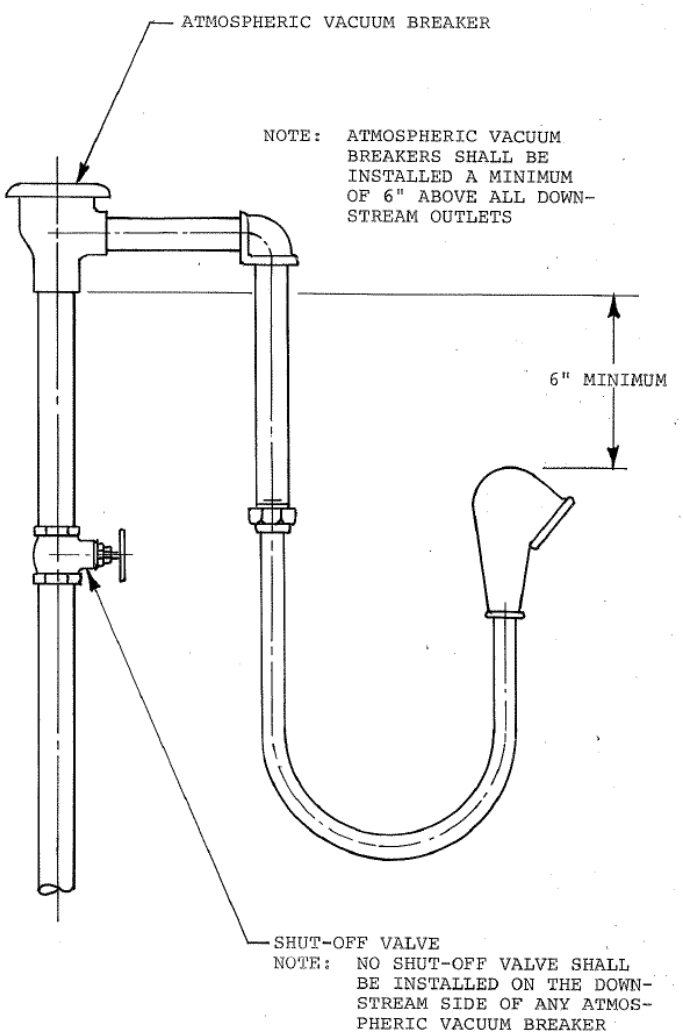


Figure 33. Atmospheric Vacuum Breaker Installation

Inspection

Atmospheric vacuum breakers should be periodically inspected to determine if:

1. The device has been removed.

2. The device has been properly installed.

3. The device is operative.

Failure of a vacuum breaker normally occurs as a result of a rupture of the rubber membrane in devices using a rubber check valve or failure of the disc in a disc type device.

Corrosion or build-up of lime deposits on the vacuum breaker seat can cause leakage or sticking of the device.

Advantages

The principle advantages of atmospheric vacuum breakers are their low cost and their ready availability.

Limitations

Atmospheric vacuum breakers do not provide protection against backflow resulting from backpressure.

Atmospheric vacuum breakers are mechanical devices that require periodic inspection and maintenance.

Hose Bibb Vacuum Breaker

The hose bibb vacuum breaker is designed specifically to be mounted on a faucet to prevent backsiphonage. It may be used on a wash basin or laboratory faucet or outside hose bib. This unit can readily be subjected to backpressure by simply having the hose outlet higher than the faucet; however this device is better than no protection at all. A typical hose bib vacuum breaker is shown in Figure 34 and an example in Figure 35.

Advantages

The principle advantages of hose bibb vacuum breakers are their low cost and their ready availability.

Limitations

Hose bibb vacuum breakers do not provide protection against backflow resulting from backpressure.

Hose bibb vacuum breakers are mechanical devices that require periodic inspection and maintenance.

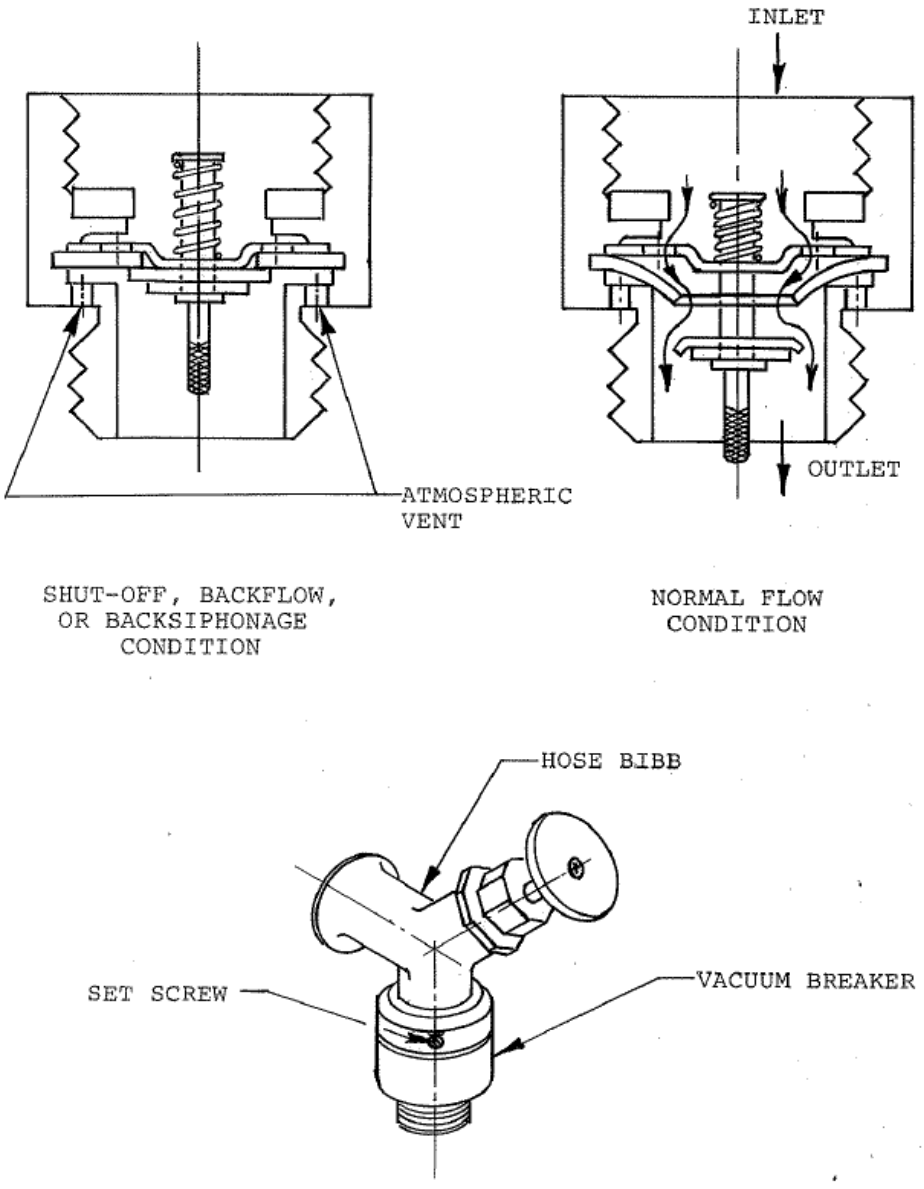


Figure 34. Hose bibb vacuum breaker

Figure 35. An application of a hose bibb vacuum breaker on a double hose connection.

Dual Check Valve

The dual check valve is made up of two internally spring-loaded, independently operating check valves. It may be subjected to backpressure or backsiphonage. During a backpressure condition, the increase in pressure will cause the valves to close. During a backsiphonage condition, the spring-loading of the check valves will cause them to close. It may be sufficient to be used as an isolation device to protect against a low hazard provided the device is certified to ASSE 1024. Typically dual check valves can be found on residential water service connections or on individual outlets. A typical dual check valve is shown in Figure 36.

Advantages

With two check valves in series, this configuration provides a backup if one check valve fails during a backflow situation.

Limitations

Dual check valves do not provide protection against a health or high hazard. Dual check valves are not testable devices, do not meet the requirements of a backflow prevention assembly and therefore, are not acceptable for containment purposes.

Dual check valves are mechanical devices that require periodic inspection and maintenance.

Figure 36. An example of a dual check valve.

SPECIFIC VALVING AND PIPING CONFIGURATIONS

Interchangeable Connections

Interchangeable connections, also known as swivel or change-over devices, include swing connectors and four-way valves. These devices operate to provide alternative, but not simultaneous, supply from either a potable or non-potable source.

These devices do not offer complete protection against backflow between the two systems which are interconnected. When used, the potable water system must be protected by an approved reduced pressure principle backflow preventer.

Two major types of interchangeable connections are as follows:

- Four-way Valves

  Where four-way valves are used for interchangeable connections, such valves must be of the lubricated plug type or of the type that operates through a mechanism which unseats the plug, turns it 90 degrees and reseats the plug. The ordinary plug cock, in which there is metal-to-metal contact, is unsatisfactory due to the tendency for the plug to freeze in one position when there are long periods between operations of the valve. Details of a four-way valve and its installation are illustrated in Figure 37A and 37B.

- Swing Connectors

  The swing connector has been used quite frequently in the past as a device to separate the public water supply from a secondary supply. The unit offers low head loss but is difficult and unhandy to change from one position to another, and therefore, is being replaced by the four-way valve. Figure 38 illustrates a typical application of this unit.

Installation Requirements

1. Four-way valves and swing connectors must have separate shut-off valves on each of the supply lines and downstream of the connection.

2. The tell-tale port of the four-way valve must be able to drain by gravity and therefore, must face down or in a horizontal position with no pipe extensions. The threads or flange on the drain port must be destroyed so that a connection cannot be made to this port.

3. The four-way valve or swing connector, when used in connection with a potable and auxiliary water supply, must have a reduced pressure principle backflow prevention assembly installed on the potable line.

Figure 37A. Installation of a four-way valve.

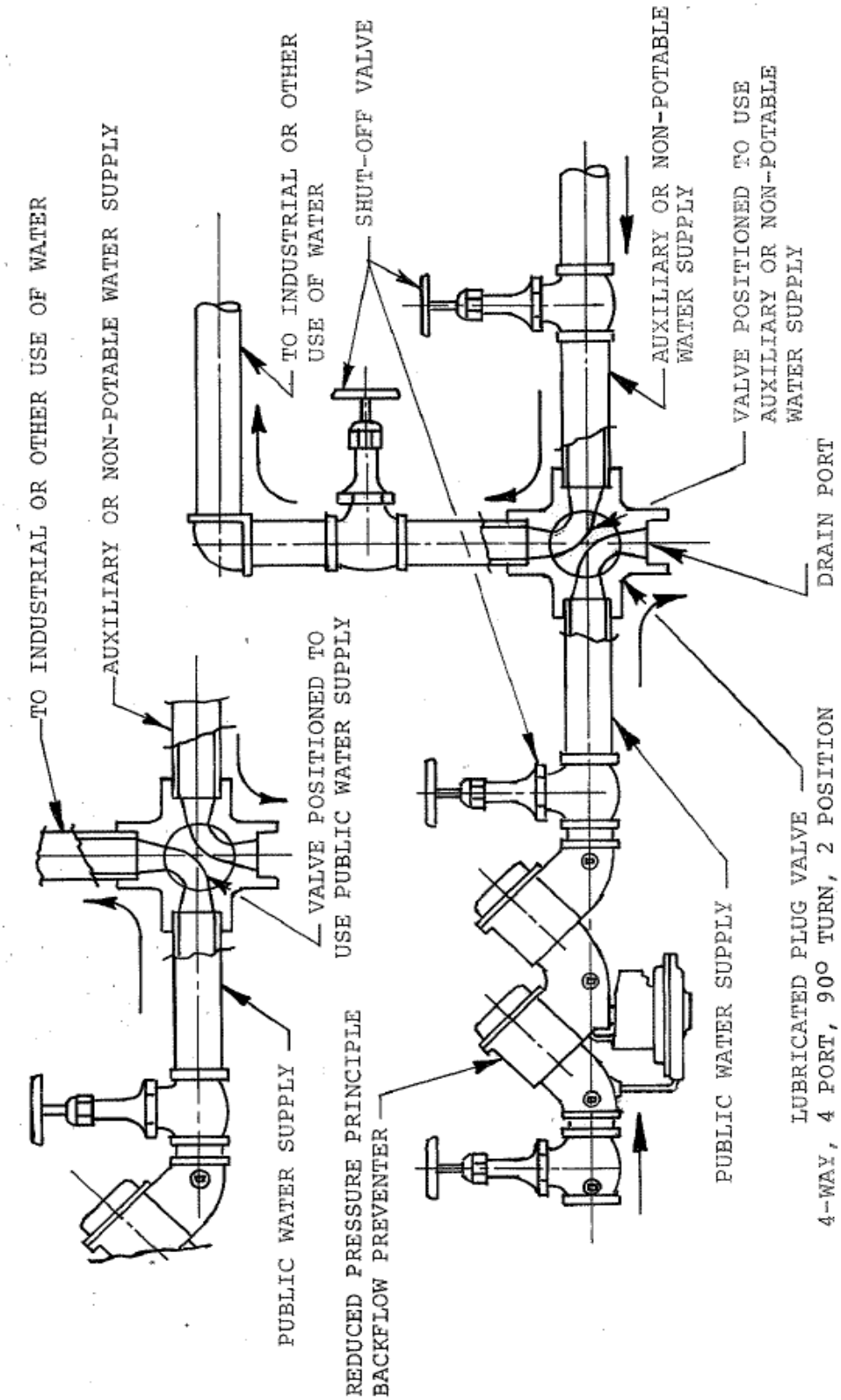


Figure 37B. Typical four-way valve installation

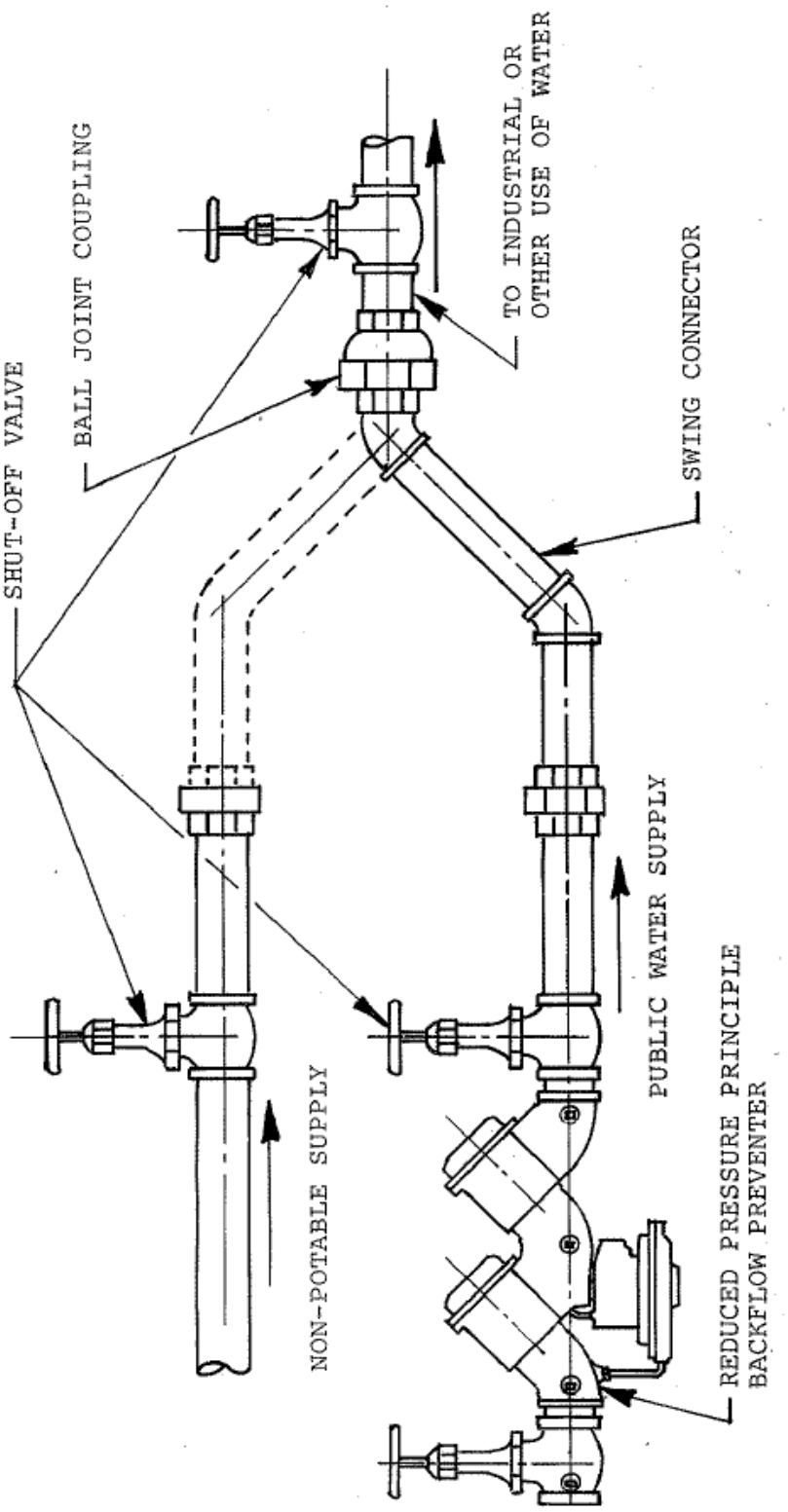


Figure 38. Swing connector installation

Advantages

1. The four-way valve is simple, compact, and has easy quarter-turn operation.

2. The swing connector has low head loss and a minimum of required maintenance.

Limitations

1. Pressure loss may be high through the backflow preventer, four-way valve, and shut-off valves.

Barometric Loop

The barometric loop as shown in Figure 39 can be installed to protect the potable water supply from backsiphonage. If there is any possibility of backpressure, some other type of protection against backflow will be required.

Atmospheric pressure, at sea level, will push a column of water approximately 34 feet high in a perfect vacuum. Therefore, the top leg of the loop must be a minimum of 35 feet above the spill rim of the highest free water surface downstream from the loop.

A single check valve is installed at the high point of a barometric loop to minimize the potential for air lift, which could occur under certain conditions. Air lift may occur when air drawn in through an un-submerged outlet during a backsiphonage condition entrains contaminants at a submerged outlet and carries them over the loop by an action similar to that of a jet pump, or lifts them by an action similar to an air-lift pump.

The device must be properly designed, must be installed so that it is adequately protected against freezing and must not be used in a position where it could be subjected to backpressure. This configuration is not recognized as a containment device and additional protection may be necessary depending on the degree of hazard.

Advantages

1. It does not require maintenance checks.

Limitations

1. Space and installation may be a problem.

2. It is subject to changes or modifications that may destroy the effectiveness of the device.

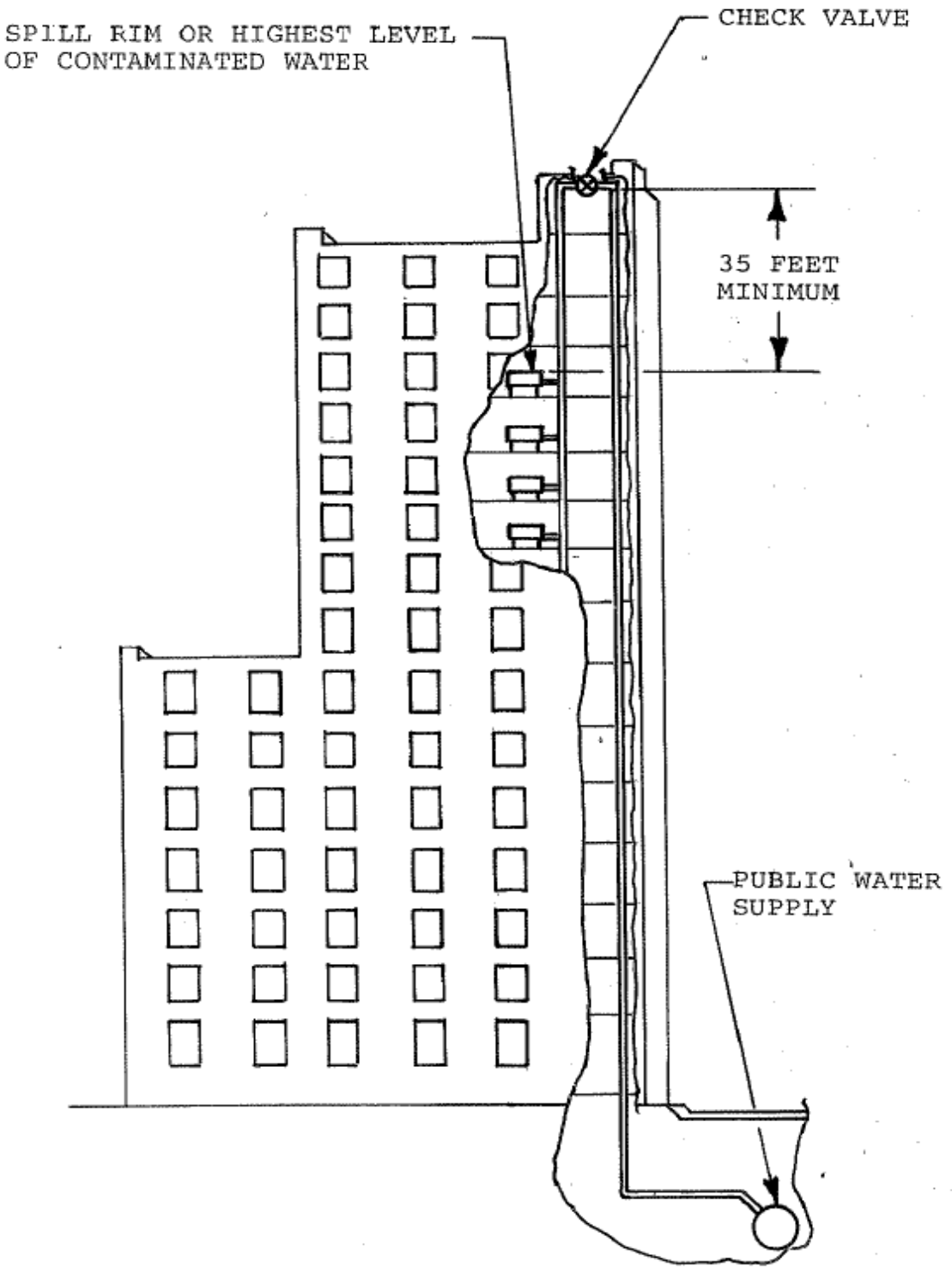


Figure 39. Barometric Loop

Spool Connection

The removable spool connection as shown in Figure 40 has been used in the past to separate the public water supply from a secondary supply. This type of protection is not acceptable as a form of protection against contamination and should be brought up to current standards through the use of an interchangeable connection.

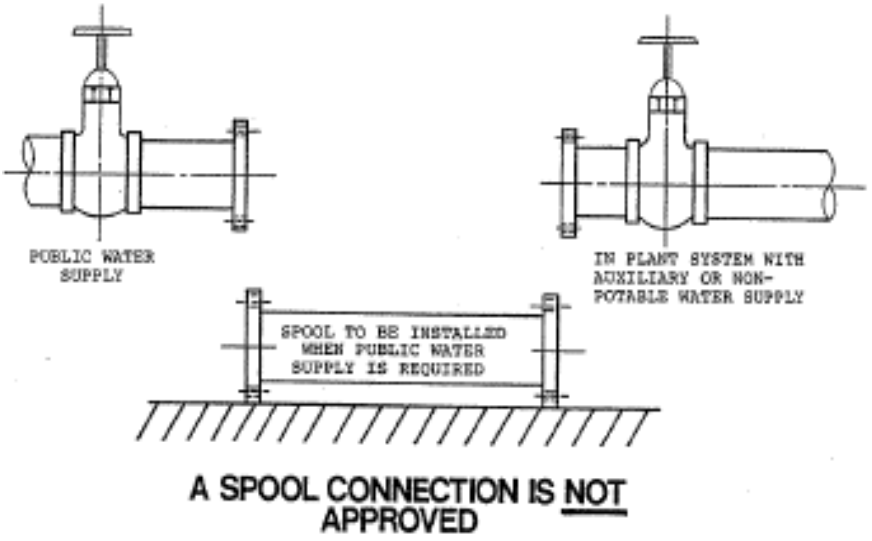


Figure 40. Spool connection (not an approved means for providing dual water supplies).

SECTION 5 - DEGREE OF HAZARD AND METHODS FOR BACKFLOW PREVENTION AND CROSS-CONNECTION CONTROL

Public water systems must be protected against contamination resulting from the backflow of objectionable fluids through cross-connections. There are various methods and assemblies designed to provide this protection. This chapter will describe acceptable methods for the prevention of backflow into public water systems.

Cross-connections can permit backflow from either backpressure or backsiphonage. Backpressure can occur whenever a customers' water system is cross-connected to any other pressurized system. Backsiphonage can occur whenever a negative or lowered pressure develops in a consumer's water system which is cross-connected to water-using fixtures or equipment. The methods and assemblies used for backflow prevention can be divided into those that are acceptable for the prevention of backflow due to backsiphonage and those that are acceptable for the prevention of backflow due to backpressure.

Each backflow prevention method and assembly must be carefully evaluated as to its merits and safety for the prevention of backflow. Some provide greater security and safety than others. The degree of hazard must be considered in determining the method and assembly to be used.

The best protection against backflow is the elimination of all cross-connections. Unfortunately, in many established buildings such as factories, power plants, and hospitals, the potable water, waste, heating and cooling piping is concealed with the building structure. Under these circumstances identification and removal of all cross-connections within the consumer's property may be impossible and a backflow prevention assembly should be installed on the service line. This type of protection is considered "backflow protection by containment", but it should be noted that this containment protects only the public water supply and does not protect the water supply on the consumer's property.

DEGREE OF HAZARD

Contamination of a public water system may occur as the result of the backflow of liquids, gases or other substances into the public water system. A hazard is created when such contaminants are in a form or concentration that would be dangerous to the health of the consumer, create a nuisance, be aesthetically objectionable, or cause physical damage to the water system. Hazards resulting from backflow may be classified as follows:

- Severe Health Hazard – Any health hazard that could reasonably be expected to result in significant morbidity or death.

- Health Hazard – Any condition, device, or practice in a water supply system or its operation that creates, or may create, a danger to the health and well-being of users.

- System Hazard – A condition, device, or practice, posing an actual or potential threat of damage to the physical properties of the public water system or a consumer's potable water system.

- Pollutional Hazard – A condition through which an aesthetically objectionable or degrading material not dangerous to health may enter the public water system or a consumer's potable water system.

The type and kind of protective method used or assembly installed should be selected by taking into account the degree of hazard involved. Severe health hazards represent the highest degree of hazard and therefore require the highest degree of protection. Health and system hazards represent a moderate degree of hazard and require a moderate degree of protection. Pollutional hazards represent a lesser degree of hazard and require a lesser degree of protection.

There is a wide range of backflow prevention assemblies available to provide the necessary containment protection for the public water system. You should be familiar with the advantages and limitations of each of the assemblies. (See Section 4.) Table 2 lists each type of hazard, minimum necessary method or assembly needed, type of certification required for the method or assembly, and the type of backflow protection provided.

Table 2. Level of hazard and appropriate containment backflow prevention.

Hazard Level	Assembly	Certification Number	Protection Provided
Severe Health	Approved Air-Gap Separation	ANSI 112.1.2	Backpressure Backsiphonage
Health System	Reduced Pressure Assembly	ASSE 1013 AWWA C511 CSA B64.4 USC - RP	Backpressure Backsiphonage
Health System (Fire System Only)	Reduced Pressure Detector Assembly	ASSE 1047 CSA B64.4.1 USC - RPDA	Backpressure Backsiphonage
Pollution	Double Check Valve Assembly	ASSE 1015 AWWA C510 CSA B64.5 USC - DCA	Backpressure Backsiphonage
Pollution (Fire System Only)	Double Check Detector Assembly	ASSE 1048 CSA B64.4.1 USC -DCDA	Backpressure Backsiphonage

The selection of the appropriate assembly, device or ancillary equipment to use is based upon an evaluation of the degree of hazard presented by the cross-connections found at the premises, which is then compared to the type of protection specified by the Ohio EPA.

AUXILIARY WATER SYSTEMS

Any water system on or available to the premises other than the public water system is called an auxiliary water system. Auxiliary water systems include used water or water from a source other that the public water system such as wells, cisterns or open reservoirs that are equipped with pumps or other prime movers, including gravity. Premises means any building, structure, dwelling or area containing plumbing or piping supplied from a public water system.

At a minimum, an auxiliary water system is considered a health hazard. When possible, the auxiliary water system should be eliminated or properly abandoned. With few exceptions, there are two protective mechanisms which must be implemented to help ensure the public water systems remain protected from auxiliary systems on the consumer's property.

First, auxiliary water system piping must remain physically disconnected from all piping through which the public water system flows. The physical separation must be visually observed and verified in writing every 12 months. (See Appendix VI for a suggested form.)

Second, a reduced pressure principle backflow prevention assembly must be installed at the meter on the public water system. This assembly must be tested every 12 months and written verification must be maintained by the purveyor of water.

An inter-connection between a public water system or a consumer's water system and an auxiliary water system is prohibited unless the auxiliary water system, the method of connection and the use of such system have been approved by the supplier of water AND by the Ohio EPA. Note Ohio EPA will consider approval under only three conditions:

1. To augment the quantity of water available from the public water system where the public water system is unable to supply the demand required by the premises,

2. Where an uninterrupted supply is necessary to prevent a catastrophic event from occurring, and

3. To provide a second source of fire protection to protect public safety.

(See the next section, dual water supplies, for further details.)

There may be exceptions where the purveyor of water has the option to waive the requirement to install a reduced pressure principle backflow assembly at the meter as long as other criteria are met. Only cases where the auxiliary water system is on the real property that is owned or under control of the consumer and adjacent to the premises can this be considered. The premises are considered any area which is supplied by the public water system. Each individual case must be carefully evaluated and must meet all of the following criteria before the requirement for a reduced pressure principle backflow assembly can be waived:

1. A physical separation must be maintained between the public water system and the auxiliary water system. (The distance of separation and ease of connection, or lack thereof, must be a deterrent for interconnection);

2. Careful consideration must be given of the history of cross-connections being established or re-established on the premises, the ease or difficulty of connecting the auxiliary water system with the public water system on the premises, the presence or absence of contaminants on the property or other risk factors;

3. The consumer must sign an agreement which specifies the penalties, (including discontinuing water service until such time the conditions are corrected or eliminated to the satisfaction of the supplier of water) for creating a connection between the public water system and the auxiliary water system;

4. An inspection at least every 12 months followed by written certification that no connection has been created between the public water system and the auxiliary system;

5. An inventory is maintained of each consumer's premises where an auxiliary water system is on or available to the premise, or on the real property adjacent to the premises;

6. An education program is developed and implemented to inform all consumers served by the public water system about the dangers of cross-connections and how to eliminate cross-connections.

(See Appendix VI for a suggested evaluation sheet, agreement and educational material for this alternative.) If the purveyor of water chooses to exercise this alternative, it requires a greater level of oversight and increases liability to ensure the public water system is safe from backflow.

DUAL WATER SUPPLIES (BACKPRESSURE)

Acceptable methods for controlling cross-connections between a consumer's water system and any other pressurized system depends on the liquid or gas that is contained in the other pressurized system, but in most cases the selection of the method of control is very easy. The basic rule is – DO NOT MAKE ANY CONNECTION BETWEEN A PIPE CARRYING THE POTABLE WATER SUPPLY AND ANY PIPE THAT MAY CARRY ANY OTHER GAS OR LIQUID UNDER PRESSURE.

A color code on piping can be helpful in identifying the contents of a pipe line, thus preventing workers on new construction and technicians from inadvertently making a cross-connection that would endanger the public water supply. Color coding also makes periodic inspections for cross-connections easier. Competent design and proper supervision of workers is necessary to prevent cross-connections.

Necessity for Dual Water Supplies

The need for making more than one water supply available in some industrial establishments must be recognized in many instances. The maintenance of dual sources of water supply in industrial establishments is usually the result of a need to augment the quantity of water available from a single source, to provide for uninterrupted water service, or to provide a secondary fire protection water supply.

THE PUBLIC HEALTH AND THE SAFETY OF THE PUBLIC WATER SUPPLY MUST RECEIVE FIRST CONSIDERATION in determining the conditions under which an auxiliary water supply is to be made available at any given place. Economic considerations must be of secondary consideration. Vigilance on the part of water works officials, building inspectors, industrial plant managers, maintenance personnel, plumbers and persons with similar responsibility is required at all times to avoid improper connections between approved and auxiliary water supplies.

Methods of Making Two Water Supplies Available for Industrial Use

The Ohio Environmental Protection Agency recognizes certain methods of making dual water supplies available, where necessary, in a safe manner. These various methods have particular applications and restrictions, depending upon the conditions surrounding each installation. It is important to note that gate valves and ordinary check valves do not, of themselves, assure the separation of two water supplies and are not approved by the Ohio Environmental Protection Agency for such purpose.

Four acceptable methods for the use of dual water supplies are outlined below. Methods 1 and 2 can be used for routine situations in which it is absolutely necessary to provide dual water supplies. Method 3 and Method 4 are acceptable where the auxiliary water supply is to be used only for fire protection.

Any proposed installation that connects an auxiliary water supply to a public water supply, except those using method No. 1 indicated below, must be submitted to the supplier of water and to the Director of the Ohio Environmental Protection Agency for approval in accordance with the requirements of Ohio Revised Code Section 6109.13 and Ohio Administrative Code Rule 3745-95-02(B). An application for detail plan approval, made in accordance with the requirements of Ohio Administrative Code 3745-91-02, along with a letter of approval from the supplier of water for the dual water supply configuration, must be submitted to Ohio Environmental Protection Agency for review and approval before installation.

- Method #1 Air Gap Separation – The public water supply may be discharged to a reservoir, tank or sump through a pipe which terminates a minimum of two pipe diameters above the highest possible water level in such reservoir, tank, or sump. The auxiliary water supply may also discharge to this basin. The water supply, whether pumped or gravitated from this tank, must not be available for drinking, culinary use, or any other potable purpose. Drinking fountains, showers, and wash room facilities must be connected to the public water supply ahead of the air gap. See Figure 41.

- Method #2 Interchangeable Connections – The consumer's water system and the private water supply may be brought to a common location. At this point, an interchangeable connection is used to alternatively connect one or the other of the

supplies to the pipe leading to the industrial or non-potable water requirement. See Figures 37B and 38 above in Section 4).

Four-way valves used for interchangeable connections should be of the “lubricated plug type” or of the type that operates through a mechanism which unseats the plug, turns it 90^{o} and reseats it. The ordinary plug clock in which there is metal-to-metal contact is unsatisfactory due to the tendency for plugs to “freeze” in one position when there are long periods between operations of the valve. Four-way valves must never be used as stop valves but must have separate stop valves on each line connected to it. The threads or flange on the drain port must be destroyed so that a connection cannot be made to this port.

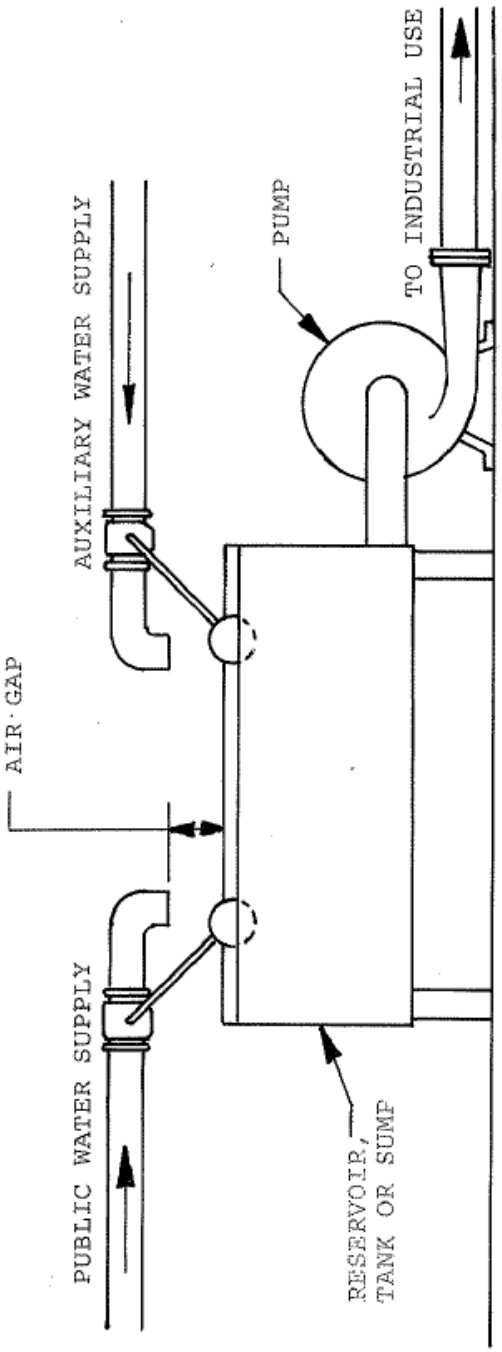


Figure 41 – Method 1: Air Gap Separation

Methods of Making Two Water Supplies Available for Fire Protection Only

In addition to the two methods previously listed, there are two additional methods that are acceptable to the Ohio Environmental Protection Agency for making water from both a public water supply and an auxiliary source available for fire protection. These acceptable methods are by the use of a double check valve assembly or the use of a reduced pressure principle backflow prevention assembly. The following two methods are acceptable for fire protection piping systems only, with no use of the water other than for fire protection permitted. See Figure 42. Plans for all installations proposed under the provisions of this section must be submitted to and have received the approval of the supplier of water and the Ohio Environmental Protection Agency under the provision of Section 6109.13 of the Ohio Revised Code and Rule 3745-95-02(B) of the Ohio Administrative Code.

- Method #3 Fire Protection Only – Double Check Valve Assembly – Plans for a fire protection system with an auxiliary water supply proposing the use of a double check valve assembly must meet all of the following requirements before it will be considered for approval by the Ohio Environmental Protection Agency:

  1. Water from the downstream side of the double check valve assembly shall be used for fire protection only.

  2. There shall be no regular use of water downstream from the double check valve assembly other than for fire system make-up water.

  3. The fire system shall be filled with water from the public water supply.

  4. The public water supply must be the primary source of water for fighting any fire.

  5. The water in the fire system must contain no additives.

  6. The auxiliary water supply must not contain any substance that could cause a system or health hazard.

  7. All double check valve assemblies shall be tested at least every twelve months using the testing procedure listed in Appendix V. Records of tests and inspections shall be filed with the supplier or water.

  Unless no hazard greater than a pollution hazard can be guaranteed, Method #4 must be applied instead.

- Method 4 Fire Protection Only – Reduced Pressure Principle Backflow Prevention Assembly – Plans for a fire protection system with an auxiliary water supply proposing the use of a reduced pressure principle backflow prevention assembly

must meet all of the following requirements before it will be considered for approval by the Ohio Environmental Protection Agency:

1. Water from the downstream side of the reduced pressure principle backflow prevention assembly shall be used for fire protection only.

2. There shall be no regular use of water downstream from the reduced pressure principle backflow prevention assembly other than for fire system make-up water.

3. The fire system shall be filled with water from the public water supply.

4. The public water supply must be the primary source of water for fighting any fire.

5. The reduced pressure principle backflow prevention assembly shall be tested for tightness at least every twelve months using the testing procedures listed in Appendix VI. Records of tests and inspections shall be filed with the supplier of water.

6. The reduced pressure principle backflow prevention assembly shall be located above ground level or floor level.

7. There shall be no connection or plug placed in the relief port of the reduced pressure principle backflow prevention assembly.

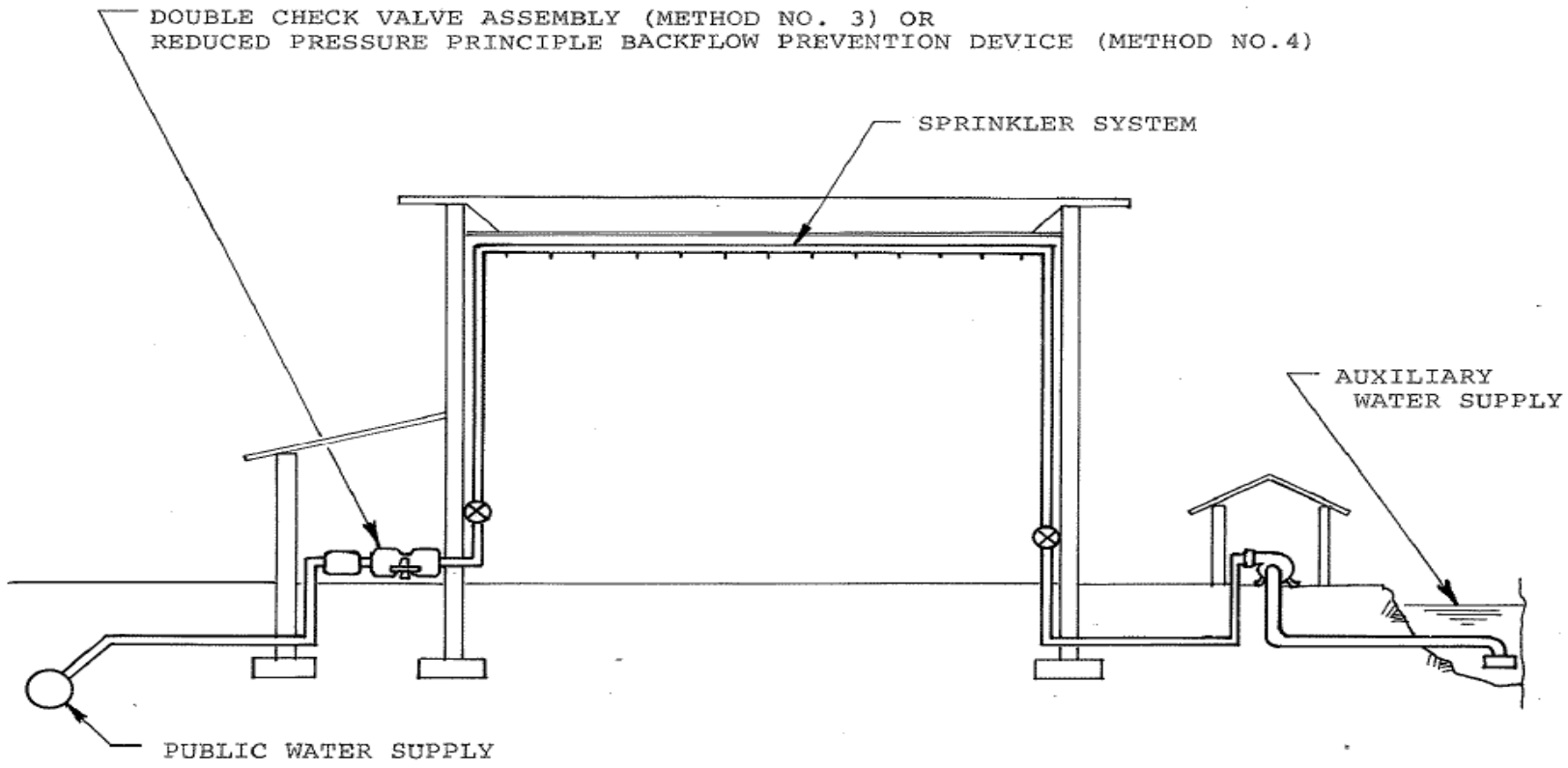


Figure 42 – Methods 3 and 4: Fire Protection

FIRE SYSTEM NOT USING AUXILIARY WATER SUPPLIES

The protection against backflow required on fire protection systems which do not include the use of auxiliary water supplies will depend on the details of the specific installation. Each installation must be evaluated individually on the basis of the degree of hazard it presents to the public water system. While the following does not cover all situations, it summarizes some typical requirements:

1. The installation of an approved backflow prevention assembly is usually not required for simple fire protection systems which contain no additives, are not equipped with booster pumps or jockey pumps, and cannot be connected to an auxiliary water supply. These are usually provided with either a simple sanitary check valve or a detector check valve. However, some suppliers of water may require the installation of an approved double check valve assembly to prevent taste and odor problems from the "breathing" of these fire systems due to water main pressure fluctuations.

2. An approved double check valve assembly is required on the public water supply line for a fire system containing a jockey pump which could cause backpressure into a public water supply connection downstream from the jockey pump, or for a system with a properly constructed auxiliary water tank filled from the public water system and equipped with a booster pump.

3. An approved reduced pressure principle backflow prevention assembly is required on the public water supply line serving a fire system containing any additive (even propylene glycol) or which can be connected to an auxiliary water supply.

In determining the degree of hazard, the local fire department should be consulted to determine their practices in regard to their use of additives and whether they connect water from auxiliary supplies through their pumpers into Siamese connections.

In addition, if a backflow prevention assembly is installed within a fire protection system, the individual qualified to test the unit may also need to have certification from the state fire marshal to test the backflow prevention assembly. It is recommended that the water purveyor contact the local/state fire marshal for advice on how to proceed.

<u>Jockey Pumps</u>

Fire protection systems that require additional backflow prevention and use a "jockey pump" (an auxiliary pump with high head and low capacity characteristics) to maintain elevated pressure in the fire protection system must arrange the pump to take suction from the public water supply system on the down-stream side of any double check valve assembly or reduced pressure principle backflow prevention assembly. A meter should be installed in series with the pump and the quantity of water used to maintain pressure

in the fire system should be recorded. Figure 43 shows an installation of a jockey pump in a fire suppression system.

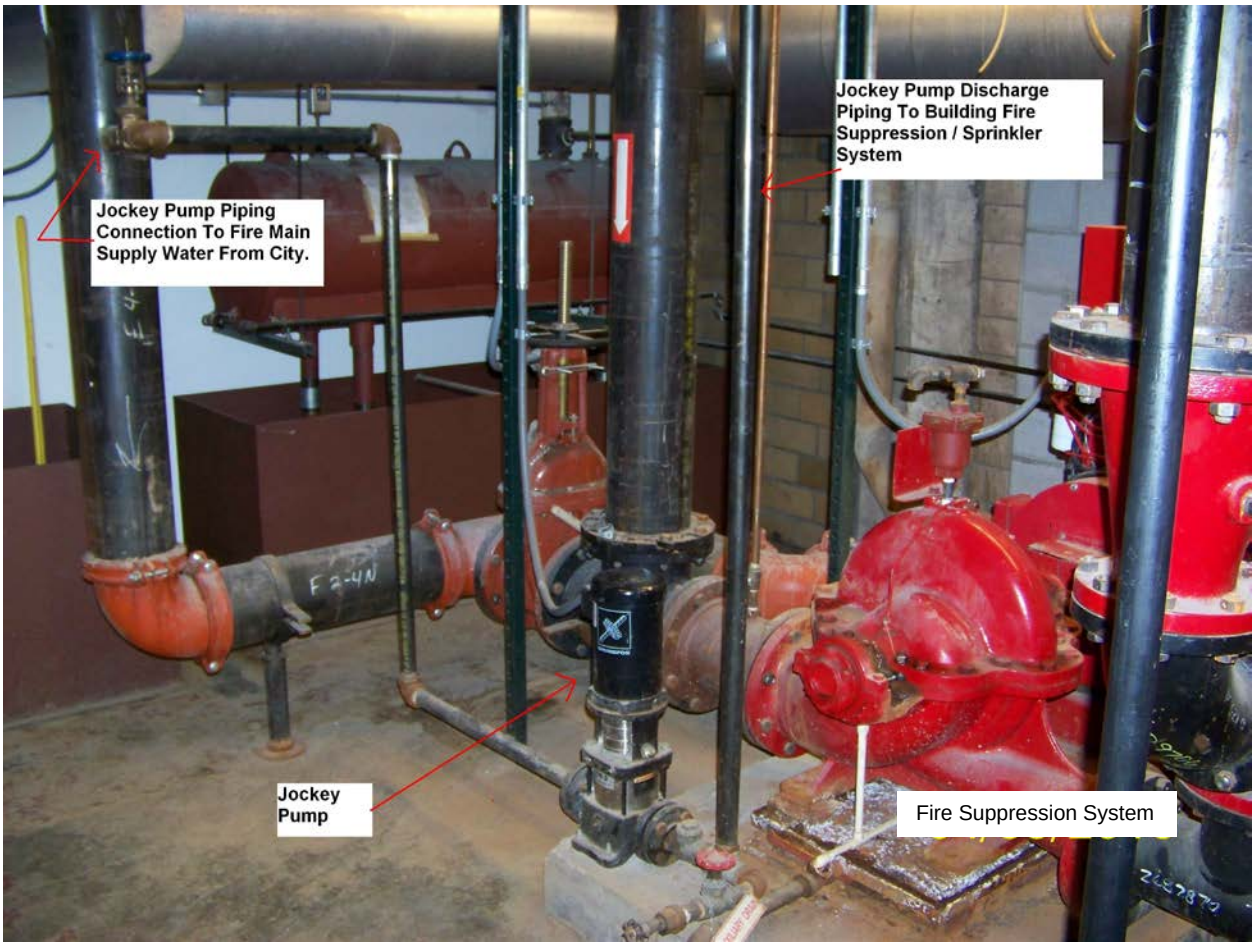


Figure 43. An example of an installation of a jockey pump in a building's fire suppression system.

BOOSTER PUMPS/LOW PRESSURE CUT-OFFS

Booster pumps should be installed only in cases where additional pressure is needed (i.e., high rise buildings and fire protection sprinkler systems at service connections and at public water system booster pump stations) and not where additional quantities of water are required. The need for additional quantities of water should be resolved by the installation of larger service lines and/or water mains in the area.

Where booster pumps are necessary at service connections, the preferred solution is to install a storage tank supplied by the public system through an acceptable air gap and then pumped to the consumer's system. This arrangement will prevent the booster pump from reducing the service line or main pressure to a level where backsiphonage

may occur. Direct connections of booster pumps to a service line or main should consider the hydraulic impacts on the distribution system in the affected area.

For a booster pump not intended to be used for fire suppression, and if it is necessary and acceptable to directly connect the suction side of a booster pump to a service line receiving water from a public water system, a low suction pressure cut-off device must be installed to prevent the pump from reducing the service line pressure below 10 psig.

For a booster pump used in a fire suppression system, also referred to as a fire pump, if it is necessary to directly connect the suction side of a fire pump to a service line receiving water from a public water system, an approved method must be in place and operational such that a minimum suction pressure of at least 10 psig is maintained. The methods acceptable under OAC Rule 3745-95-07 are: a low suction pressure cut-off device (only for installations prior to August 8, 2008 which are not or will not be significantly modified); or, a low suction throttling valve; or, a variable speed suction limiting control system installed to prevent the pump from reducing the service line pressure below 10 psig.

See Ohio Administrative Code Rule 3745-95-07 for detailed rule language. (See LAW W*riter*® Ohio Laws and Rules website at http://codes.ohio.gov/ to view this rule and other regulations in Ohio.)

The water purveyor may require additional containment backflow prevention, specifically a reduced pressure principle backflow preventer at the service connection, to maintain sanitary control of their water system.

Operation

1. The low suction pressure cut-off device is electrical and consists of a controller unit which is designed to shut down the booster pump driving motor or engine when the water supply pressure drops to 10 psig or less at the suction side of the pump. No automatic reset may be provided. Once shut down, the pump must be restarted manually.

2. An acceptable method of preventing the electrical cut-off device from shutting off the booster pump is by hydraulically controlling the volume of water discharged by the pump. This method includes the installation of a pilot-controlled/hydraulically-operated low suction throttling valve on the booster pump discharge which throttles, when necessary, the discharge of the pump so that the suction pressure will not be reduced below 10 psig while the pump is operating.

3. For booster pumps not used in fire suppression systems, a low suction pressure cut-off device must be provided in all installations even if a low suction throttling valve is also used.

4. For a booster pump used in a fire suppression system, Ohio EPA rules changed on August 8, 2008, to allow and require the use of only a low suction throttling valve for installations of booster pumps solely for fire protection purposes. The rule now also includes the option of a variable speed suction limiting control on the fire pump. A variable speed suction limiting control is a speed control system used to maintain a minimum positive suction pressure at the pump inlet by reducing the pump driver speed while monitoring pressure in the suction piping through a sensing line, so that suction pressure will not be reduced below 10 psig while the pump is operating.

Specifications

The low suction pressure cut-off device, the low suction throttling valve, as well as the variable speed suction limiting control system must meet the standards of Factory Mutual or Underwriter's Laboratories.

PLUMBING SYSTEMS (BACKSIPHONAGE)

There should never be a negative pressure in a water supply piping system. Unfortunately combinations of events and circumstances sometimes are such that low or negative pressure may occur. Plumbing fixtures represent cross-connection hazards which must be mitigated through the use of isolation devices or methods to protect against backflow through backsiphonage.

Rule 4101:3-6-01, Section 608 of the Ohio Administrative Code covers acceptable methods to be used in preventing backflow from plumbing fixtures for protection of the potable water supply. The local building departments, local health departments, or the Division of Industrial Compliance generally have jurisdiction over plumbing downstream of the service connection (and required meters and containment backflow prevention assemblies). The type of isolation device and level of protection required is outlined in the plumbing code. Acceptable methods of protecting water supplies from backflow from plumbing fixtures and similar storage containers include:

- Method A – Air Gap Separation – The preferable method for all installations is an air gap separation where the water supply discharge is above the flood rim of the fixture or equipment as described by the American National Standards Institute Standard A112.1.2 under the conditions of Rule 4101:3-6-01, Section 608.13.1 of the Ohio Administrative Code.

- Method B – Pressure Type Vacuum Breaker – Where the use of an air gap is not possible, or may be circumvented, the use of a pressure type vacuum breaker meeting American Society of Sanitary Engineering Standard 1020 or Canadian Standards Association B64.1.2 under the conditions of Rule 4101:3-6-01, Section 608.13.5 of the OAC is satisfactory.

- Method C – Atmospheric Type Vacuum Breaker – When neither Method A nor B protection (as indicated above) is practical, an atmospheric type vacuum breaker meeting ASSE Standard 1001 or CSA B64.1.1 under the conditions of Rule 4101:3-6-01, Section 608.13.6 of the OAC may be installed on the discharge side of the manually controlled valve used to control the discharge of water to the fixture or equipment.

- Method D – Double Check Valve Assembly or Reduced Pressure Principle Backflow Prevention – When none of Methods A, B or C protection (as indicated above) is practical, a double check valve assembly meeting ASSE Standard 1015, CSA B64.5 or AWWA C510, or a reduced pressure principle backflow prevention device meeting ASSE Standard 1013, CSA B64.4 or AWWA C511 respectively, may be installed under the conditions of Rule 4101:3-6-01, Section 608.13.2 and Section 608.13.7 of the OAC.

OTHER HAZARDS

Water Operated Sump Pumps/Devices

Some devices use the pressure provided by the public water system to operate. For example, water-operated backup sump pumps for homes and businesses utilize water pressure through the venturi principle instead of electricity to power the movement of collected sump water to the building's drains. Such a configuration creates a cross-connection between the potable public water supply and liquid of a questionable quality. Due consideration must be given to the level of protection that is necessary to mitigate the hazard associated with the cross-connection. If alternative means exist which do not utilize water pressure or public water supply to operate the unit, they should take priority.

Specifically for water-operated backup sump pumps the following shall be taken into consideration:

1. Water-operated sump pumps pose a potential backflow hazard by way of a cross-connection between the drinking water supply and the contaminated water in the sump pit. This hazard is increased during flooding conditions. The main sump pump offers a potential of imposing backpressure against the water supply line to the water-operated backup sump pump if the discharge lines are combined. A majority of these pumps provide a vacuum breaker device for protection against backsiphonage. A vacuum breaker device would not provide the level of protection necessary if a backpressure situation should occur and would be made obsolete if it became submerged during a flooding situation.

2. The public water system purveyor must analyze each household or building considering installation of a water-operated sump pump on an individual basis to determine if a backflow hazard has been mitigated.

3. In all situations in which a water-operated backup sump pump is installed, the main sump pump and the water-operated backup sump pump should have completely separate discharge piping. Separate discharge piping is necessary if the backflow preventer installed is not rated for backpressure.

4. The installation of water-operated backup sump pump units should also be coordinated with the local building department, local health department, or the Ohio Department of Commerce, Industrial Compliance Division which regulates larger residential and commercial plumbing applications. For installation in a non-residential building, one of these authorities will approve the plans and inspect the plumbing installation to ensure that proper backflow prevention is provided. For residential buildings, the proposed plumbing installation may be reviewed and inspected where a local certified building department or a local health department is available to enforce the plumbing code. Water-powered sump pumps are permitted in the Ohio Plumbing Code. At time of issuance, the relevant sections of the OPC include sections 608.3, 608.12, 608.16.6, and 1113.1.5 (Rules 4101:3-6-01 and 4101:3-11-01 of the Administrative Code).

Figure 44 provides a schematic of a type of water-operated backup sump pump.

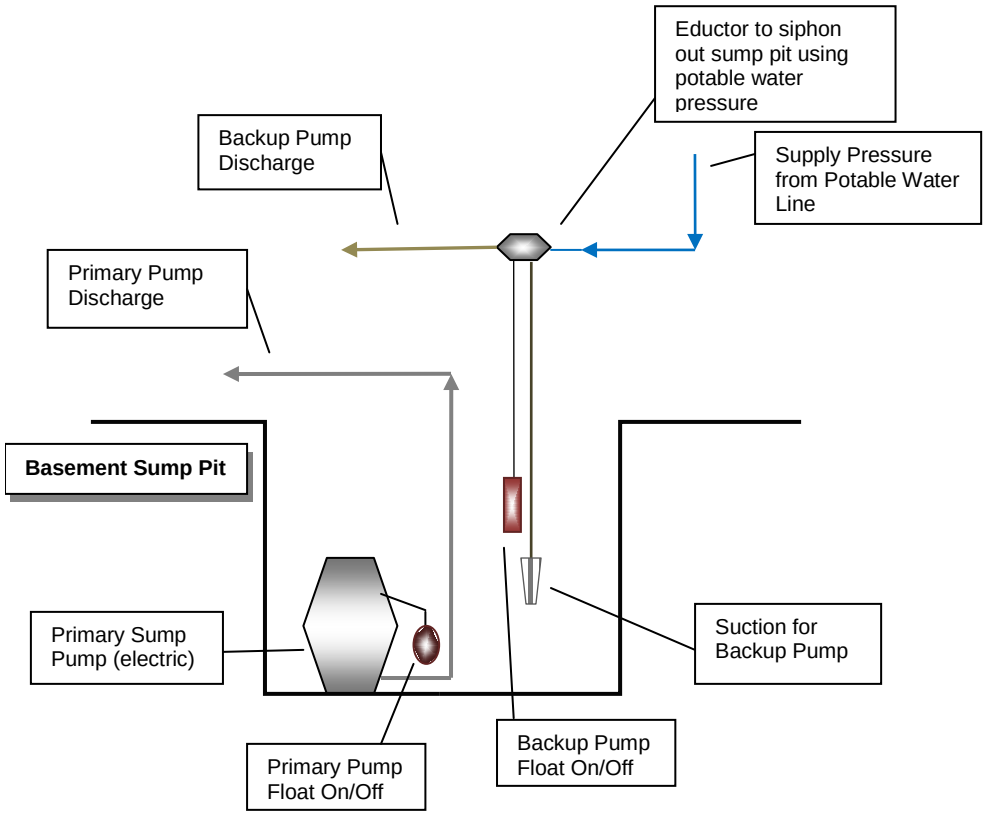


Figure 44. Schematic of a water-operated backup sump pump installation which uses potable water supply to facilitate suction of fluids from the sump pit to discharge location if primary pump fails.

Yard Hydrants

Yard hydrants are commonly used in areas where water is needed away from a building. Figure 45A illustrates an installation of a yard hydrant. The standard yard hydrant consists of a head for attaching a hose, a riser pipe and a shutoff valve below the frost level. Yard hydrants are often equipped with weep holes below ground. When the hydrant is shut off, the weep holes in the valve open, allowing the water from the riser to drain into the soil below the frost line. The self-draining yard hydrant inherently provides protection against freezing. Weep holes are illustrated in Figure 45B.

Yard hydrants, in general, create a potential for backsiphonage every time they are shut off, as the draining riser creates a siphon at the hose bib. Protection should be provided by installing a hose bib vacuum breaker on all yard hydrants where a hose can be attached.

The self-draining yard hydrants with weep holes are a hazard because of the potential for contamination associated with the weep hole being in contact with the soil. If the stopper in a standard hydrant with weep holes leaks, it is likely to be undetectable at ground level as it is leaking out the weep hole into the ground. When a backsiphonage condition occurs, the leak 'out' becomes a leak 'in', siphoning contaminated water into the public water system. Also, if the ground water level fluctuates where the water table rises above the weep hole, the riser will fill with contaminated water. Each time the hydrant is shut off and the weep hole opens, contaminated water could migrate into the hydrant. Each time the hydrant is turned on, contaminated water could enter the public water system.

The most practical solution is to install a yard hydrant that does not have a weep hole. Freeze protection can be provided by manually draining the hydrant seasonally, or utilizing a type of hydrant referred to as a sanitary yard hydrant that is freeze resistant or frost proof. Those that meet American Society of Sanitary Engineers (ASSE) Sanitary Yard Hydrant Standard 1057 are examples of hydrants that do not utilize weep holes.

The ASSE Sanitary Yard Hydrant Standard 1057 requires that yard hydrants not drain directly into the ground and it must have a backflow preventer if a hose is capable of attachment. It also stipulates minimum required pressure and flow capabilities and ensures proper freeze protection. Yard hydrants that meet the requirements of ASSE Standard 1057 can be accepted by the public water system.

The public water system has jurisdiction over yard hydrants which they own as part of the distribution system and must ensure the requirements for yard hydrants are met according to OEPA rule. These requirements include no weep holes on yard hydrants used or accessible for potable purposes. This includes those located in public cemeteries, parks, on public buildings property, etc. Also, public water systems such as campgrounds, schools or mobile home parks, have the responsibility to ensure the requirements for yard hydrants are met. Yard hydrant requirements are fully outlined in Ohio Administrative Code Rule 3745-95-09. (See LAW W*riter*® Ohio Laws and Rules website at http://codes.ohio.gov/ to view this rule and other regulations in Ohio.)

Yard hydrants located on private property served by a public water system must be considered when determining the degree of hazard and the necessary backflow prevention required at the meter. Yard hydrants with weep holes present a hazard as well as those with unprotected hose bibb connections.

Figure 45A. An installation of a self-draining, non-sanitary type yard hydrant.

Figure 45B. Cross-section of non-sanitary type yard hydrant with weep hole.

Geothermal Heating and Cooling Systems

If a geothermal heating and/or cooling system is installed at a premises served by the public water system, the system must be considered when identifying any hazards to the public water system. Two different scenarios have been identified:

In a closed loop system, a heat transfer fluid is recirculated through a loop of piping installed below ground or within a surface water body. No withdrawal of groundwater is involved. An antifreeze additive may be used to facilitate the heat exchange which may be toxic. The components of the geothermal heating and/or cooling system must be kept completely separate, physically, from any plumbing or fixtures supplied by the public water system. If the potential exists such that the heat transfer fluid from the geothermal system can be introduced into the plumbing supplied by the public water system, a reduced pressure principle backflow prevention assembly must be installed at the service connection.

If a geothermal system is an open loop system, such that water for circulation is pumped from a well and discharged to another well or surface water, consideration must be given to whether or not the non-potable supply can be introduced into the potable water supply provided by the public water system. The potable and non-potable supply piping must be completely separated, physically, and an appropriate backflow preventer installed at the service connection. If the potential exists such that fluid from the geothermal system (including the water source, circulating fluid, or discharge) can be introduced into the plumbing supplied by the public water system, a reduced pressure principle backflow prevention assembly must be installed at the service connection.

For a public water system that uses an approved well for both a source of drinking water and a source for the heat exchange fluid in an open-looped geothermal system, a reduced pressure principle backflow prevention assembly must be installed on the leg to the geothermal system supply. In addition, no toxic additives can be used in direct contact with the water. Discharge to surface water must also be through an air gap.

Gray Water Systems and Rain Water Harvesting Systems

Gray water systems can be defined as a system that treats and reuses wastewater discharged from lavatories, bathtubs, showers, clothes washers, and laundry sinks that does not contain food wastes or bodily wastes. A gray water piping system usually contains a collection basin and pumps or gravity design and piping to carry collected used water to non-potable fixtures such as for flushing toilets or irrigation.

A rainwater harvesting system can be defined as storm water that is conveyed from a building roof, stored in a cistern and disinfected and filtered before use. Typically, when public water supply is available, the collected rainwater has been used for toilet flushing or landscape irrigation. These systems can be equipped with tanks and pumps to move the collected water.

Both of these systems represent an auxiliary water supply and pose a hazard for backflow into the public water system supply and into the consumer's water supply.

The potable system supplied by the public water system must be kept physically separated from the gray water system or the rainwater harvesting system and a reduced pressure principle backflow prevention assembly must be installed at the service connection. The potable supply may supplement the non-potable supply through the use of an air gap and tank configuration. In addition, the Ohio plumbing code would prohibit any physical connection between a make-up water line from the potable water system and the gray water system (see code reference in Appendix I). All plumbing and fixtures available for use for human consumption purposes must be supplied with potable water. The non-potable piping should be labeled or color-coded, and a food grade dye should be used in the non-potable supply as an indicator of the source of supply and to differentiate it from the potable water supply.

SECTION 6 - COMPONENTS OF A GOOD PROGRAM

SURVEY AND INVESTIGATION OF EXISTING HAZARDS

A survey and on-site investigation must be made of the consumer's premises in order to determine the hazard to the public water system. The survey must determine:

1. The water uses on the consumer's premises;

2. The existence of cross-connections;

3. The existence of any auxiliary water supplies;

4. The use or availability of any pollutants, contaminants or other liquid, solid or gaseous substances.

The scheduling of surveys and on-site investigations should be prioritized based on known hazards and the degree of hazard associated with certain industries and buildings.

The following operational procedure is suggested:

- Prepare a Street and Area Map. This map should show property lines, street locations, street names and numbers, the location and size of street water mains and the location, number and size of each of the water services and meters.

  Prepare Field Survey and Investigation Sheets. The field survey and investigation sheet should show the meter number and size, the location and type of backflow prevention assemblies, the owner's name and address, and other pertinent data. See the suggested "cross-connection survey and investigation forms" located in Appendix V.

- Contact the Owner. Contact the owner or manager of the premises to inform him/her why it is necessary to survey and investigate his/her water uses and in-plant water system. The owner should be informed of the relationship between cross-connections and water-borne diseases; the types of health hazards and cross-connections normally found in this type of operation; the methods for cross-connection control and elimination; the duties and liabilities of the owner; and the laws; regulations, rules and policies relating to water use and the cross-connection control program. Permission to make the survey and investigation should be obtained. The owner should be asked to participate in the survey and investigation or to furnish a competent engineer or supervisor who is familiar with the water system. The owner's blueprints, when such are available, may be helpful, however

they should not be depended upon to be representative of conditions as installed. In every case the information provided by the owner must be field checked during the survey and investigation.

- Make a Survey and On-site Investigation of the Premises. A survey and on-site investigation should be made of every foot of exposed piping. The underground system should be checked as accurately as possible. A sketch should be made of the in-plant water system. Each water line should be followed to its end and a survey made to determine whether there are actual or potential cross-connections or conditions that might tend to contaminate the potable water system.

- Prepare a Summary of Findings. The individual performing the survey and on-site investigation should prepare a list of all cross-connections found and recommend methods for their elimination or control. The recommendations must be practical and realistic.

CONTROL OF NEW INSTALLATIONS

Backflow prevention and cross-connection control for new installations must be addressed and should be accomplished by a combination of plan reviews and field inspections.

Plans for new installations should be evaluated prior to construction to determine the degree of hazard to the potable water system. This will serve to eliminate hazards that are easily identified. If adequate plans and specifications are not available and no realistic evaluation of proposed water uses can be made, the consumer should be advised that the installation of backflow prevention assemblies or other controls may be necessary.

Field inspections during or immediately after construction will serve to identify hazards that were not apparent during plan reviews or were introduced during construction.

Plans for the installation of plumbing must be submitted to the regulatory agency having jurisdiction. These are municipal building departments certified by the Ohio Board of Building Standards, local health departments having plumbing inspectors certified by the Ohio Department of Commerce, or the Division of Industrial Compliance plumbing section.. The regulatory agency having jurisdiction is responsible for field inspection to determine compliance with plumbing regulations.

When a continuous supply is deemed necessary for industrial or fire protection purposes, plans for inter-connections to auxiliary water supplies as a secondary source must be submitted to the supplier of water and to the Ohio Environmental Protection Agency for review and approval before such connections are installed. The connections are only allowed for industrial use with an approved interchangeable

connection for continuous supply, but not a simultaneous supply, from both sources. Connections for fire protection are permitted if the water supply is only used for the fire protection system and the potable water supply is protected with an acceptable backflow prevention assembly on the service line to the fire protection system and at the service connection.

Plans for the installation of backflow prevention assemblies for the purpose of containment must be submitted to the supplier of water for review and approval. The supplier of water is responsible for the on-site investigation to confirm appropriate containment is in place for new installations.

An effective program for the control of new installations requires cooperation between the supplier of water, the water consumer, and the regulatory agencies.

INSPECTION AND MAINTENANCE OF BACKFLOW PREVENTION ASSEMBLIES

Regular inspection, testing and maintenance of backflow prevention assemblies and appropriate records of the results of these tests are essential parts of a backflow prevention program.

The water consumer is responsible for maintaining the backflow prevention assemblies and devices in proper working order. This requires frequent inspections of all backflow prevention devices, periodic testing of vacuum breakers, double check valve assemblies and reduced pressure principle backflow prevention assemblies. Records of inspections, testing, and repairs must be maintained as evidence of having met this responsibility.

The water consumer is responsible for reporting to the supplier of water the operating status of the backflow prevention assemblies installed on the consumer's water system. The method must be inspected, or the assembly must be tested, by an individual acceptable to the public water system. A complete record of each method or assembly must be maintained by the water consumer. This shall include a comprehensive log from purchase to retirement of all tests, inspections and repairs.

- Air Gap Devices. All air gap devices must be inspected at least every 12 months to determine that they have not been bypassed.

- Pressure Vacuum Breakers. All pressure vacuum breakers must be tested at least every 12 months for evidence of mechanical failure and for proper installation.

- Double Check Valve Assemblies. All double check valve assemblies must be tested before they are placed in service. Test procedures are outlined in Appendix V.

The frequency of testing shall be a maximum of twelve (12) months between tests. If the test shows that leakage occurs, the assembly must be dismantled, internally inspected and repaired immediately.

- Reduced Pressure Principle Backflow Prevention Assemblies. All reduced pressure principle backflow prevention assemblies should be observed periodically for evidence of leakage through the relief valve port.

  They must be tested at the time they are placed in service or repaired, and at least every twelve months thereafter. Test procedures are outlined in Appendix V. More frequent tests may be required where the assembly shows evidence of deterioration due to water quality, operating conditions, age or other causes.

  If continued dumping of water occurs the assembly shall be immediately dismantled, inspected internally, and repaired or replaced by a new or rebuilt unit.

- Interchangeable Connections. All interchangeable connections must be inspected at least every 12 months to determine that they have not been improperly modified and that no piping connection has been made to the tell-tale port of a four-way valve.

- Booster Pump Low Suction Pressure Cut-off Devices, Low Suction Throttling Valves and Variable Speed Suction Limiting Controls. All booster pump low pressure cut-off devices, low suction throttling valves and variable speed suction limiting control systems, must be inspected and tested for proper operation at the time of installation and at least every 12 months thereafter.

FREQUENCY OF REINSPECTION

Ohio EPA regulations require that periodic surveys and investigations of water use practices within a consumer's premises be conducted to determine whether there are actual or potential cross-connections to the consumer's water system through which contaminants or pollutants could backflow into the public water system. Such actions are necessary to ensure the proper containment backflow preventer is in place for the water use practices at the service connection. New and existing service connections need to be under this program.

An onsite investigation must be conducted for all service connections likely to have a pollutional, system, health or severe health hazard, every five years. The supplier of water may document, in writing, a different methodology to identify, on an on-going basis, changes in water use practices at consumer's premises that potentially or actually, represent a new or increased hazard to the potable water supply. This methodology could include survey questionnaires filled out by the consumer or supplier of water or include triggers to identify water use practices and likely hazards. Triggers could include notification from other local licensing agencies typically involved when a

change in water use practice occurs, such as building, zoning, health or fire protection or those which are under the jurisdiction of the supplier of water including, a new or additional meter request or a new or additional service line. A survey or trigger indicating a likely water use practice that would result in the need for additional or higher level of backflow prevention must be followed up with an on-site investigation to ensure the hazard has been adequately addressed. For residential premises, without a likely hazard, an ongoing educational campaign, in accordance with OAC Rule 3745-95-03 can be used to fulfill the rule requirement for periodic surveys and investigations. See Appendix VI for a suggested method of achieving the rule requirement for surveys and investigations.

RECORDKEEPING

The supplier of water must maintain comprehensive records to support their due diligence in carrying out the requirements of a backflow prevention and cross-connection control program. Such records include reports of surveys and investigations conducted and required backflow preventer installations for as long as they remain relevant. Forms outlining testing results, inspection or related repairs to required backflow preventers must be maintained. These forms must be kept for a minimum of a rolling five year period and should be kept for the service life of the backflow preventer to provide a history of performance. Records should facilitate recalling the hazards onsite, locating backflow prevention device installations and verifying the make and model numbers of containment devices. Pictures and drawings gathered at the time of the survey would be helpful. Various computer software programs are available to make storage, filing and retrieval of information more efficient.

QUALIFICATIONS FOR INDIVIDUALS WHO OVERSEE A BACKFLOW PREVENTION PROGRAM AND TEST BACKFLOW PREVENTERS

The individual in charge of a backflow prevention program at a public water system must either be the 'operator of record' or under the authority of the 'operator of record'[1]. Ohio EPA recommends that an individual in charge of a backflow prevention program has successfully completed a training course about backflow prevention theory and containment backflow prevention assembly testing procedures. The Ohio Department of Commerce (ODOC) is the state's licensing agency for backflow prevention device testers and Ohio EPA recommends that an ODOC certified tester provide for testing of containment assemblies under the public water system's jurisdiction. Individuals should meet the criteria for eligibility to take the certification exam which includes holding a minimum of a Class 1, Ohio EPA Water Treatment Operator, or Water Distribution System Operator, license and have five years' experience in water distribution, or as specified under the ODOC rules. Individuals tasked to test isolation devices within plumbing systems will have to meet the requirements outlined in the ODOC Division of Industrial Compliance regulations regarding plumbing found in OAC Rule 1301:3-7-02 and ORC 3703.21.

In addition, if a backflow prevention assembly is installed within a fire protection system, the tester may also have to have certification from the state fire marshal to test and repair the backflow prevention assembly. Typically, the location of the backflow preventer will dictate who the qualified tester is. It is recommended that the water purveyor consult with the state fire marshal to ensure that the installer is certified when a fire suppression system may be impacted. It is also recommended that the water purveyor consult with the local building department to ensure that the pressure loss through the backflow prevention assembly has been accounted for in the design of the suppression system.

[1] In situations where backflow prevention program personnel are managed under a different organizational unit than operations, a written protocol should address how duties are delegated, who is held responsible for ensuring enforcement of the backflow prevention rules and how the operator is kept informed of the status of the program to ensure its adequacy.

CHECKLIST FOR A GOOD BACKFLOW PREVENTION PROGRAM

In order to ensure a public water system has and maintains an adequate backflow prevention program, the following components will be addressed during a system's sanitary survey by the field office staff of Ohio EPA. A public water system must have these components addressed and be ready to discuss them at the time of a survey:

1. Does the water system have a cross-connection control ordinance or other legal mechanisms that are used to control cross-connections? (Indicate all mechanisms used.)

    a. Ordinances

    b. Service Contract

    c. Rental Agreement?

    d. By-Laws?

    e. Other (explain in notes)?

        - *In order to have an enforceable program, the system needs to have either an ordinance on the books or requirements in the by-laws.*

2. Does the cross-connection control program include the following:

    a. Requires installation and operation of appropriate type of approved backflow preventer?

- *The backflow preventers have to appropriately protect the system in accordance with the potential degree of hazard and must be testable (OAC 3745-95-04)*

b. Provides right-of-entry for inspection?

- *Rules must permit entrance into a premises served by the PWS to conduct a thorough inspection of all water uses on-site.*

c. Conducts inspections/tests for all installed backflow preventers every 12 months?

- *The installed assemblies/air gaps have to be inspected and tested at least once every 12 months (not annually). The most recent inspection/test report must be made available.*

d. Enforces discontinuance of service to any facility where suitable or operable backflow preventers have not been provided for a cross-connection?

- *The PWS has to have the right to cut off water service to any service connection where the backflow preventers are not properly maintained and tested.*

e. Require appropriate protection and inspection of all other booster pump installations?

f. Ensure that customers with auxiliary water systems (i.e. private wells) have the appropriate backflow protection and inspection?

- *Service connections must have a physical separation between the PWS and the auxiliary water system **and** a proper backflow preventer unless the PWS follows all the requirements of OAC 3745-95-04 (C)(2)*

3. Who does the water system accept to perform the every 12-month inspection on the backflow prevention assemblies?
   a. Department of Commerce Certified Tester

   b. OTCO Certified Tester

   c. Licensed Plumber

   d. PWS Personnel

   e. Other

4. Have all existing customers required to have backflow prevention been identified?

    - *Not just industrial, institutional and larger commercial users, but also small commercial users, rural customers with auxiliary water systems or yard hydrants and residential users with underground irrigation systems or booster pumps must be surveyed*.

5. Is there a mechanism to identify the need for backflow prevention on new service connections?

    - *PWS should have construction inspection completed prior to connecting initial tap.*

6. Does the system periodically resurvey all customers to ensure that cross-connections have been identified?

    - *Service connections must be re-surveyed with an on-site investigation or other approved documented methodology to determine current water use practices and changes which may warrant additional protection.*

7. Are backflow preventers at treatment plants and other facilities owned by the water system/ municipality tested every 12 months?

    - *The installed assemblies/air gaps have to be inspected and tested at least once every 12 months. The most recent inspection/test report must be made available.*

8. Are air gaps provided on all bulk water sale stations?

    - *All bulk water stations have to be equipped with air gaps which cannot be compromised.*

9. Who in the organization is trained in cross-connection control?

    - *The whole public water system staff needs to be trained in cross-connection control in order to be able to run a good program. It takes more than just the chief operator to get the work done.*

APPENDICES

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Suggested Forms for Reports on Inspection, Tests and Maintenance

APPENDIX I

STATE OF OHIO LAWS AND RULES PERTAINING TO BACKFLOW PREVENTION AND CROSS-CONNECTION CONTROL

Ohio state laws and Ohio state rules pertaining to backflow prevention and cross-connection control are contained in the Revised Code and in rules of the Ohio Environmental Protection Agency and Ohio Department of Commerce - Division of Industrial Compliance and the Ohio Building Code. Those statutes and rules which appear to be directly concerned with backflow prevention are listed below. For an up-to-date listing and for the text of the regulations, see LAW W*riter*® Ohio Laws and Rules website at http://codes.ohio.gov/.

[Chapter 4101:3-6 (the Ohio Plumbing Code) of the Ohio Administrative Code, entitled Plumbing, is part of the Ohio Basic Building Code and contains rules on water supply and distribution that are directly concerned with backflow prevention and cross-connection control. Rules are provided for informational purposes only. See Ohio Department of Commerce, Industrial Compliance, Plumbing website for the most up-to-date and complete listing of these rules athttp://www.com.ohio.gov/dico/ Another web link resource is from the International Code Council Online Library, under electronic products tab, free resources heading, then free codes, state of Ohio code, at: http://publicecodes.cyberregs.com/st/oh/st/OH-P-2011-000004.htm]

[Chapter 3745-95 (Ohio EPA, Backflow Prevention and Cross-Connection Control) of the Ohio Administrative Code became effective on July 1, 1972. The rules undergo a review every five years. These rules are provided for informational purposes only. See Ohio EPA's Division of Drinking and Ground Waters website for an up-to-date and complete listing of the rules by clicking on the tab, "Effective Rules" at http://epa.ohio.gov/ddagw/rules.aspx.

Ohio Board of Building Standards

Ohio Revised Code

- Section 3781.03 – Enforcement of building standards
  - 3781.06 – Jurisdiction of the building standards; definitions
  - 3781.10 – Duties of the Board of Building Standards
  - 3781.11 – Rules and regulations of the Board of Building Standards
  - 3791.01 – General prohibitions
  - 3791.02 – Prohibition: owner's failure to obey orders; penalty
  - 3791.03 – Prohibitions: others; penalty
  - 3791.04 – Submission of plans; approvals

Ohio Administrative Code

- Division 4101:3 Ohio Plumbing Code

4101:7 Certification Rules
Rule 4101:8-25-01 Residential Code of Ohio, “Plumbing Systems” chapter

Ohio Division of Industrial Compliance

Ohio Revised Code

Section 3703.01 – Division of Industrial Compliance powers and duties
3703.03 – Division to enforce rules governing plumbing and plan approval
3703.05 – Right of entry for plumbing inspectors
3703.06 – Plumbing certificates: issuance, posting, revocation
3703.07 – Plumbing permit required; fee
3703.08 – Duty of the owner to comply with notices
3703.10 – Prosecutions and proceedings for violations
3703.21 – Backflow advisory board; Certification of backflow technicians; civil penalty
3703.99 – Penalties

Ohio Administrative Code

Rule 1301:3-2-02 – Definitions
1301:3-2-03 – Examination for Plumbing Inspector Certification
1301:3-2-04 – Jurisdiction of Plumbing Inspector
1301:3-2-05 – Certificate required for Plumbing inspector
1301:3-2-06 – Certificate Renewal
1301:3-2-07 – Fees for Plumbing inspectors
1301:3-2-08 – Denial, revocation or suspension of a Plumbing inspectors certificate
1301:3-2-09 – Appeals for Plumbing inspector certificates

Rule 1301:3-7-01 – Definitions
1301:3-7-02 – Certification as a Backflow Technician
1301:3-7-03 – Backflow Technician Examination
1301:3.7.04 – Fees for backflow application and examination
1301:3.7.05 – Renewal of Certificate as a Backflow Technician
1301:3.7.06 – Training agency for backflow technician education
1301:3.7.07 – Denial, revocation or suspension of a backflow certificate
1301:3.7.08 – Appeal for backflow technician

Ohio Environmental Protection Agency

Ohio Revised Code

Section 6109.04 – Control of public water systems
6109.07 – Plan submittal and approval
6109.13 – Auxiliary water systems
6109.14 – Notice of the danger of contamination
6109.15 – Orders to make improvements, corrections and changes
6109.31 – Violations
6109.32 – Enforcement actions

6109.33 – Penalties
6109.34 – Access for inspections and investigations

Ohio Administrative Code
Rule 3745-95-01 – Backflow prevention and cross-connection control definitions
3745-95-02 – Cross-connections
3745-95-03 – Surveys and investigations
3745-95-04 – Where protection is required
3745-95-05 – Type of protection required
3745-95-06 – Backflow prevention devices
3745-95-07 – Booster pumps
3745-95-08 – Violations
3745-95-09 – Requirement for yard hydrants

Chapter 3745-91 – Plan Approval (Rules 3745-91-01 through 3745-91-09)

Ohio Department of Health

Ohio Revised Code
Chapter 3729. – Recreational vehicle parks, recreation camps, combined and temporary park-camps

Ohio Administrative Code
Chapter 3701-25 – Camps
Chapter 3701-26 – Recreational vehicle park, combined park-camps and temporary park-camps (i.e., rule on park or camp water supply; backflow prevention on water supply)

The following portions of the Ohio Revised Code concern the powers and duties of political subdivisions and private companies in Ohio regarding the establishment, operation, maintenance and protection of public water systems and the regulation of plumbing systems within buildings.

County Systems

Section 307.15 – Board of county commissioners; contracts with other units of Government
307.37 – Construction in unincorporated areas
307.38 – County building inspector; duties; hearings
307.381 – County board of appeals may be established
307.40 – Unlawful construction may be enjoyed

Chapter 6103. – County water supply systems; definitions
Section 6115.04 – Sanitary districts: organization and purposes
6115.18 – Sanitary districts: powers of the board of directors
6115.19 – Sanitary districts: organized to provide a water supply

6115.23 – Sanitary districts: board of directors may make and enforce Regulations; noncompliance

Municipal Corporations

Section 715.01 – General powers
715.08 – Water supply
715.26 – Building regulation: erection; inspection; removal; repair
715.29 – Sanitation
717.01 – Specific powers: acquisition of public works
731.17 – Procedures for legislation
735.02 – Director of Public Service: duties
735.03 – Board of Public Utilities
735.27 – Villages: care of public institutions
735.273 – Village Administrator: powers and duties
735.29 – Board of Public Affairs: powers and duties
743.02 – Utilities: bylaws and regulations
743.12 through 743.16 – Extension of water service outside the corporation limits; supervision; protection
743.17 – Water works in a contiguous municipal corporation; protection
743.24 – Contract for a water supply; protection

PUCO Regulated Utility Companies

Chapter 4933. – PUCO regulated utility companies

Conservancy Districts

Section 6101.04 – Conservancy districts: organizations and purposes
6101.13 – Official plan; execution
6101.15 – Powers of the board of directors
6101.19 – Board of directors may make and enforce rules and regulations

Regional Water and Sewer Districts

Section 6119.01 – Organization; purpose
6119.06 – Rights, powers and duties
6119.07 – Powers vested in a board of trustees
6119.08 – Rules and regulations
6119.35 – Approval or rejection of plans by the Ohio Environmental Protection Agency

APPENDIX II

SUGGESTED ORDINANCE ON BACKFLOW PREVENTION

ORDINANCE NO …….

TO PROVIDE AN EFFECTIVE MEANS FOR PROTECTING THE PUBLIC WATER SYSTEM FROM CONTAMINATION DUE TO BACKFLOW OF CONTAMINANTS THROUGH THE WATER SERVICE CONNECTION INTO THE PUBLIC WATER SYSTEM.

WHEREAS, Section 6109.13 of the Ohio Revised Code requires protection of the public water system from contamination through any connection whereby water from a private, auxiliary or emergency water system may enter the public water system; and

WHEREAS, Section 3745-95 of the Ohio Administrative Code requires protection of the public water system from contamination due to backflow of contaminants through the water service connection; and

WHEREAS, the Ohio Environmental Protection Agency requires the maintenance of a continuing program of backflow prevention and cross-connection control which will systematically and effectively prevent the contamination of all potable water systems; and

WHEREAS, in order to accomplish these goals it is necessary to introduce restrictions that go beyond usual plumbing code requirements; now, therefore,

BE IT ORDAINED by the council of the city (or village) of ……., state of Ohio:

SECTION 1. That if, in the judgment of the Superintendent of Water, an approved backflow prevention assembly is necessary for the safety of the public water system, the Superintendent of Water will give notice to the water consumer to install such an approved assembly immediately. The water consumer shall, at his own expense, install such an approved assembly at a location in a manner approved by the Superintendent of water and shall have inspections and tests made of such approved assemblies as required by the Superintendent of Water.

SECTION 2. That no person, firm or corporation shall establish or permit to be established or maintain or permit to be maintained any connection whereby a private, auxiliary or emergency water supply other than the regular public water supply of ……. may enter the supply or distributing system of said municipality, unless such

private, auxiliary or emergency water supply and the method of connection and use of such supply shall have been approved by the Superintendent of Water of ……. and by the Ohio Environmental Protection Agency.

SECTION 3. That it shall be the duty of the Superintendent of Water to cause surveys and investigations to be made of industrial and other properties served by the public water supply where actual or potential hazards to the public water supply may exist. Such surveys and investigations shall be made a matter of public record and shall be repeated as often as the Superintendent of Water shall deem necessary.

SECTION 4. That the Superintendent of Water of ……. or his or its duly authorized representative shall have the right to enter at any reasonable time any property served by a connection to the public water supply or distribution system of ……. for the purpose of inspecting the piping system or systems thereof. On demand the owner, lessees or occupants of any property so served shall furnish to the Superintendent of Water any information which he may request regarding the piping system or systems or water use on such properly. The refusal of such information, when demanded, shall, within the discretion of the Superintendent of Water, be deemed evidence of the presence of improper connections as provided in this ordinance.

SECTION 5. That the Superintendent of Water of ……. is hereby authorized and directed to discontinue, after reasonable notice to the occupant thereof, the water service to any property wherein any connection in violation of the provisions of this ordinance is known to exist, and to take such other precautionary measures as he may deem necessary to eliminate any danger of contamination of the public water supply distribution mains. Water service to such property shall not be restored until such conditions shall have been eliminated or corrected in compliance with the provisions of this ordinance.

SECTION 6. This ordinance shall take effect and be in force from and after the _____ day of _____, 20_____. APPENDIX III

SUGGESTED REGULATIONS ON BACKFLOW PREVENTION AND CROSS-CONNECTION CONTROL

Section 1. Cross-Connection Control – General Policy

A. Purpose. The purpose of these Rules and Regulations is:

1. To protect the public potable water supply from contamination or pollution by isolating within the consumer's water system contaminants or pollutants which could backflow through the service connection into the public water system.

2. To promote the elimination or control of existing cross-connections, actual or potential, between the public or consumer's potable water system and non-potable water systems, plumbing fixtures and sources or systems containing process fluids.

3. To provide for the maintenance of a continuing program of backflow prevention and cross-connection control which will systematically and effectively prevent the contamination or pollution of the public and consumer's potable water systems.

B. Application. These Rules and Regulations shall apply to all premises served by the public water system of the _____.
(city, village, company, etc.)

C. Policy. The Superintendent of Water shall be responsible for the protection of the public water system from contamination due to backflow of contaminants through the water service connection. If, in the judgment of the Superintendent of Water, an approved backflow prevention assembly is necessary at the water service connection to any consumer's premises for the safety of the water system, the Superintendent of Water or his authorized representative shall give notice to the consumer to install such approved backflow prevention assembly at each service connection to his premises. The consumer shall immediately install such approved assembly or assemblies at this own expense, and failure, refusal or inability on the part of the consumer to install such assembly or assemblies immediately shall constitute grounds for discontinuing water service to the premises until such assemblies have been installed.

Section 2. Definitions.

A. The following definitions shall apply in the interpretation and enforcement of these rules and regulations:

1. “Air gap separation” means the unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture, or other device and the flood level rim of the receptacle.

2. “Approved” means that a backflow prevention device or method has been accepted by the supplier of water and the director as suitable for the proposed use.

3. “Auxiliary water system” means any water system on or available to the premises other than the public water system and includes the water supplied by the system. These auxiliary waters may include water from another supplier’s public water system; or water from a source such as wells, lakes, or streams; or process fluids; or used water. They may be polluted or contaminated or objectionable or constitute a water source or system over which the supplier of water does not have control.

4. “Backflow” means the flow of water or other liquids, mixtures, or substances into the distributing pipes of a potable water supply from any other source other than the intended source of the potable water supply.

5. "Backflow preventer" means any assembly, device, method, or type of construction intended to prevent backflow into a potable water system. Where backflow prevention device is used in other rules of this chapter (OAC 3745-95), this definition applies.

6. “Consumer” means the owner or person in control of any premises supplied by or in any manner connected to a public water system.

7. “Consumer’s water system” means any water system, located on the consumer’s premises, supplied by or in any manner connected to a public water system. A household plumbing system is considered to be a consumer’s water system.

8. Containment principle backflow preventer – A backflow preventer that is installed in a consumer’s water system, that is intended to contain the water within the premises to prevent any polluted or contaminated water from backflowing into the public water system. Typically the containment principle backflow preventer is placed at the service connection, unless placement is otherwise specified by rule herein.

9. “Contamination” means an impairment of the quality of the water by sewage or process fluid or waste to a degree which could create an actual hazard to the public health through poisoning or through spread of disease by exposure.

10. “Cross-connection” means any arrangement whereby backflow can occur.

11. “Degree of hazard” is a term derived from an evaluation of the potential risk to health and the adverse effect upon the potable water system.

12. “Director” means the director of the Ohio Environmental Protection Agency or his duly authorized representative.

13. “Double check valve assembly” means an assembly composed of two single, independently acting, check valves including tightly closing shutoff valves located at each end of the assembly and suitable connections for testing the water-tightness of each check valve.

14. “Health hazard” means any condition, device, or practice in a water system or its operation that creates, or may create, a danger to health and well-being of users. The word “severe” as used to qualify “health hazard” means a hazard to the health of the user that could reasonably be expected to result in significant morbidity or death.

15. “Interchangeable connection” means an arrangement or device that will allow alternate but not simultaneous use of two sources of water.

16. “Non-potable water” means water not safe for drinking, personal, or culinary use.

17. “Person” means the state, any political subdivision, public or private corporation, individual, partnership, or other legal entity.

18. “Pollution” means the presence in water of any foreign substance that tends to degrade its quality so as to constitute a hazard or impair the usefulness or quality of the water to a degree which does not create an actual hazard to the public health but which does adversely and unreasonably affect such waters for domestic use.

19. “Potable water” means water which is satisfactory for drinking, culinary, and domestic purposes and meets the requirements of the Ohio Environmental Protection Agency.

20. "Premises" means any building, structure, dwelling or area containing plumbing or piping supplied from a public water system.

21. “Process fluids” means any fluid or solution which may be chemically, biologically or otherwise contaminated or polluted in a form or concentration such as would constitute a health, pollutional, or system hazard if introduced

into the public or a potable consumer's water system. This includes, but is not limited to:

a. polluted or contaminated waters;
b. process waters;
c. used waters originated from the public water system which may have deteriorated in sanitary quality;
d. cooling waters;
e. contaminated natural waters taken from wells, lakes, streams, or irrigation systems;
f. chemicals in solution or suspension; and
g. oils, gases, acids, alkalis, and other liquid and gaseous fluids used in industrial or other processes, or for fire fighting purposes.

22. "Public water system" has the meaning ascribed to such term in Section 6109.01 and 6109.02 of the Ohio Revised Code.

23. "Reduced pressure principle backflow prevention assembly" means an assembly containing a minimum of two independently acting check valves together with an automatically operated pressure differential relief valve located between two check valves. During normal flow and the cessation of normal flow, the pressure between these two checks shall be less than the supply pressure. In case of leakage of either check valve, the differential relief valve, by discharging to the atmosphere, shall operate to maintain the pressure between the check valves at less than the supply pressure. The unit must include tightly closing shutoff valves located at each end of the device, and each device shall be fitted with properly located test cocks.

24. "Service connection" means the terminal end of a service line from the public water system. If a meter is installed at the end of the service, then the service connection means the downstream end of the meter.

25. "Supplier of water" means the owner or operator of a public water system.

26. "System hazard" means a condition posing an actual or potential threat of damage to the physical properties of the public water system or a potable consumer's water system.

27. "Pollutional hazard" means a condition through which an aesthetically objectionable or degrading material not dangerous to health may enter the public water system or a potable consumer's water system.

28. "Used water" means any water supplied by a supplier of water from a public water system to a consumer's water system after it has passed through the service connection and is no longer under the control of the supplier.

Section 3. Water System.

A. The water system shall be considered as made up of two parts: the public water system and the consumer's water system.

B. The public water system shall consist of the source facilities and the distribution system, and shall include all those facilities of the water system under the control of the Superintendent of Water up to the point where the consumer's water system begins.

C. The source shall include all components of the facilities utilized in the production, treatment, storage and delivery of water to the public distribution system.

D. The public distribution system shall include the network of conduits used for delivery of water from the source to the consumer's water system.

E. The consumer's water system shall include those parts of the facilities beyond the service connection which are utilized in conveying water from the public distribution system to points of use.

Section 4. Cross-Connections Prohibited.

A. No water service connection shall be installed or maintained to any premises where actual or potential cross-connections to the public potable or consumer's water system may exist unless such actual or potential cross-connections are abated or controlled to the satisfaction of the Superintendent of Water.

B. No connection shall be installed or maintained whereby water from an auxiliary water system may enter a public water system and the method of connection and use of such system shall have been approved by the Superintendent of Water and by the Director of the Ohio Environmental Protection Agency as required by Section 6109.13 of the Ohio Revised Code.

Section 5. Survey and Investigations.

A. The consumer's premises shall be open at all reasonable times to the Superintendent of Water, or his authorized representative, for the conduction of surveys and investigations of water use practices within the consumer's premises to determine whether there are actual or potential cross-connections to the consumer's water system through which contaminants or pollutants could backflow into the public potable water system.

B. On request by the Superintendent of Water, or his authorized representative, the consumer shall furnish information on water use practices within his premises.

C. It shall be the responsibility of the water consumer to conduct periodic surveys of water use practices on his premises to determine whether there are actual or potential cross-connections in his water system through which contaminants or pollutants could backflow into his or the public potable water system.

Section 6. Where Protection Is Required.

A. An approved backflow prevention assembly shall be installed on each service line to a consumer's water system serving premises, where in judgment of the Superintendent of Water or the Director, actual or potential hazards to the public potable water system exist.

B. An approved backflow prevention assembly shall be installed on each service line to a consumer's water system serving premises where the following conditions exist:

1. Premises having an auxiliary water system, unless such auxiliary system is accepted as an additional source by the Superintendent of Water and the source is approved by the Director of the Ohio Environmental Protection Agency;

2. Premises on which any substance is handled in such a fashion as to create an actual or potential hazard to the public potable water system. This shall include premises having sources or systems containing process fluids or waters originating from the public potable water system which are no longer under the sanitary control of the Superintendent of Water;

3. Premises having internal cross-connections that, in the judgment of the Superintendent of Water, are not correctable, or intricate plumbing arrangements which make it impractical to determine whether or cross-connections exist;

4. Premises, where, because of security requirements or other prohibitions or restrictions, it is impossible or impractical to make a complete cross-connection survey;

5. Premises having a repeated history of cross-connections being established or re-established;

6. Others specified by the Superintendent of Water or the Director.

C. An approved backflow prevention assembly shall be installed on each service line to a consumer's water system serving, but not necessarily limited to, the following types of facilities unless the Superintendent of Water or the Director determines that no actual or potential hazard to the public water system exists:

1. Hospitals, mortuaries, clinics, nursing homes;
2. Laboratories;
3. Piers, docks, waterfront facilities;
4. Sewage treatment plants, sewage pumping stations or storm water pumping stations;
5. Food or beverage processing plants;
6. Chemical plants;
7. Metal plating industries;
8. Petroleum processing or storage plants;
9. Radioactive material processing plants or nuclear reactors;
10. Car washes;
11. Others specified by the Superintendent of Water or the Director.

D. An approved backflow prevention assembly shall be installed at any point of connection between the public or consumer's water system and an auxiliary water system, unless such auxiliary system is accepted as an additional source by the Superintendent of Water and the source is approved by the Director of the Ohio Environmental Protection Agency.

Section 7. Type of Protection Required.

A. The type of protection required under Sections 6.A, 6.B and 6.C of these regulations shall depend on the degree of hazard which exists as follows:

1. An approved air gap separation shall be installed where the public water system may be contaminated with substances that could cause severe health hazard;

2. An approved air gap separation or an approved reduced pressure principle backflow prevention assembly shall be installed where the public water system may be contaminated with any substance that could cause a system or health hazard;

3. An approved air gap separation or an approved reduced pressure principle backflow prevention assembly or an approved double check valve assembly shall be installed where the public water system may be polluted with substances that could cause a pollutional hazard not dangerous to health.

B. The type of protection required under Section 6.D of these regulations shall be an approved air gap separation or any approved interchangeable connection.

C. Where an auxiliary water system is used as a secondary source of water for a fire protection system, the provisions of Section 7.B for an approved air gap separation or an approved interchangeable connection may not be required, provided:

1. At premises where the auxiliary water system may be contaminated with substances that could cause a system or health hazard, the public consumer's potable water system shall be protected against backflow by installation of an approved reduced pressure principle backflow prevention assembly;

2. At all other premises, the public or consumer's potable water system shall be protected against backflow by installation of either an approved reduced pressure principle backflow prevention assembly or an approved double check valve assembly;

3. The public or consumer's potable water system shall be the primary source of water for the fire protection system;

4. The fire protection system shall be normally filled with water from the public or consumer's potable water system;

5. The water in the fire protection system shall be used for fire protection only, with no regular use of water from the fire protection system downstream from the approved backflow prevention assembly;

6. The water in the fire protection system shall contain no additives.

Section 8. Backflow Preventers.

A. Any backflow preventer required by these rules and regulations shall be of a model or construction approved by the Superintendent of Water and the Director and shall comply with the following:

1. An air gap separation, to be approved, shall be at least twice the diameter of the supply pipe, measured vertically above the tope rim of the vessel, but in no case less than one inch. It shall meet the requirements of OAC Rule 3745-95-04 of the Ohio Environmental Protection Agency

2. A double check valve assembly or a reduce pressure principle backflow prevention assembly shall be approved by the Superintendent of Water, and shall meet the requirements of OAC Rule 3745-95-04 of the Ohio Environmental Protection Agency.

3. An interchangeable connection, to be approved, shall be either a swing type connector or a four-way valve mechanism which unseats the plug, turns it ninety degrees and reseats the plug. Four-way valves shall stop valves on each pipe connected to the valve. The telltale port on the four-way valve shall

have no piping connected and the threads or flange on this port shall be destroyed so that a connection cannot be made.

B. Existing backflow preventers approved by the Superintendent of Water or the Director of the Ohio Environmental Protection Agency at the time of the installation and properly maintained shall, except for inspection, testing and maintenance requirements, be excluded from the requirement of Section 8.A of this regulation providing the Superintendent of Water is assured that they will satisfactorily protect the public potable water system. Whenever the existing backflow preventer is moved from the present location or requires more than minimum maintenance or when the Superintendent of Water finds that the maintenance of the backflow preventer constitutes a hazard to health, the backflow preventer shall be replaced by a backflow prevention assembly meeting the requirements of these regulations.

Section 9. Installation.

A. Backflow prevention assemblies required by these rules and regulations shall be installed at a location and in a manner approved by the Superintendent of Water and at the expense of the water consumer. In addition, any backflow prevention assembly required by Section 7.B and 7.C of these regulations shall be installed at a location and in a manner approved by the Director of the Ohio Environmental Protection Agency as required by Section 6109.13 of the Ohio Revised Code.

B. Backflow prevention assemblies installed on the service line to a consumer's water system shall be located on the consumer's side of the water meter, as close to the meter as is reasonably practical, and prior to any other connection.

C. Pits or vaults shall be of water-tight construction, be so located and constructed as to prevent flooding and shall be maintained free from standing water by means of either a sump and pump or a suitable drain. Such sump pump or drain shall not connect to a sanitary sewer nor permit flooding of the pit or vault by reverse flow from its point of discharge. An access ladder and adequate natural or artificial lighting shall be provided to permit maintenance, inspection and testing of the backflow prevention device.

D. Reduced pressure principle backflow prevention assembly must be installed above ground level or floor level, whichever is higher.

Section 10. Inspection and Maintenance.

A. It shall be the duty of the consumer at any premises on which backflow-preventers required by these regulations are installed to have inspections, tests, and overhauls made in accordance with the following schedule, or more often where inspections indicate a need:

1. Air gap separations shall be inspected at the time of installation and at least every twelve months thereafter;

2. Double check valve assemblies shall be inspected and tested for tightness at the time of installation and at least every twelve months thereafter.

   They shall be dismantled, inspected internally, cleaned and repaired whenever needed.

3. Reduced pressure principle backflow prevention assemblies shall be inspected and tested for tightness at the time of installation and at least every twelve months thereafter.

4. Interchangeable connections shall be inspected at the time of installation and at least every twelve months thereafter.

B. Inspections, tests, and overhauls of backflow prevention assemblies shall be made at the expense of the water consumer and shall be performed by the Superintendent of Water or a person approved by the Superintendent of Water as qualified to inspect, test and overhaul backflow prevention assemblies.

C. Whenever backflow prevention assemblies required by these regulations are found to be defective, they shall be repaired, overhauled or replaced at the expense of the consumer without delay.

D. The water consumer must maintain a complete record of each backflow preventer from purchase to retirement. This shall include a comprehensive listing that includes a record of all tests, inspections, repairs and overhauls. Records of inspections, tests, repairs and overhaul shall be submitted to the Superintendent of Water.

E. Backflow preventers shall not be bypassed, made inoperative, removed or otherwise made ineffective without specific authorization by the Superintendent of Water.

Section 11. Booster Pumps.

A. For booster pumps not intended to be used for fire suppression, such booster pump shall be equipped with a low pressure cut-off designed to shut-off the booster pump when the pressure in the service line on the suction side of the pump drops to ten pounds per square inch gauge or less.

B. For booster pumps, or fire pumps, used for fire suppression installed after August 8, 2008, such booster pump, or fire pump, shall be equipped with one of the following:

1. A low suction throttling valve on the booster pump discharge, which throttles the discharge of the pump when necessary so that suction pressure will not be reduced below ten pounds per square inch gauge while the pump is operating; or,

2. The fire pump is equipped with a variable speed suction limiting control on the booster, or fire, pump. The speed control system must be used to maintain a minimum suction pressure of ten pounds per square inch gauge at the pump inlet by reducing the pump driver speed while monitoring pressure in the suction piping through a sensing line.

C. It shall be the duty of the water consumer to maintain the low pressure cut-off device ,low suction throttling valve, or variable speed suction limiting control, in proper working order and to certify to the Superintendent of Water, at least once every twelve months that the minimum pressure sustaining method in place is operating properly.

Section 12. Violations.

A. The Superintendent of Water shall deny or discontinue, after reasonable notice to the occupants thereof, the water service to any premises wherein any backflow prevention device required by these regulations is not installed, tested and maintained in a manner acceptable to the Superintendent of Water, or if it is found that the backflow preventer has been removed or by-passed, or if an unprotected cross-connection exists on the premises, or if the minimum pressure sustaining method required by these regulations is not installed and maintained in working order.

B. Water service to such premises shall not be restored until the consumer has corrected or eliminated such conditions or defects in conformance with these regulations and to the satisfaction of the Superintendent of Water.

APPENDIX IV

CRITERIA FOR APPROVED BACKFLOW PREVENTERS FOR CONTAINMENT

Ohio EPA Division of Drinking and Ground Waters now recognizes an “approval by rule” process for acceptable backflow prevention for containment

A backflow prevention air gap or assembly is approved for use as containment provided:

1. The backflow prevention air gap or assembly is certified against one of the standards listed in OAC Rule 3745-95-06, and

2. It is acceptable to the supplier of water.

Ohio EPA no longer maintains a list of approved devices. The manufacturer and/or supplier of the backflow preventer will be able to provide a copy of a certificate from one of the accredited testing agencies indicating the assembly has met one of the listed standards for the particular make, model, size and installation type (horizontal and/or vertical).

APPENDIX V

INSPECTION, TESTING AND MAINTENANCE PROCEDURES FOR BACKFLOW PREVENTERS

Maintenance and regular inspection of backflow preventers are integral parts of any backflow prevention program.

Responsibility for installing and maintaining the backflow preventer rests with the water consumer. Each backflow preventer must be inspected at regular intervals and records of the inspection, testing, and repairs made available to the supplier of water and/or the regulatory agency.

The supplier of water and the regulatory agency should be prepared to give technical assistance in the installation of the backflow preventer. For example, the following figures, A-1 and A-2 show proper installation of an RP in a horizontal position and in a vertical position. Assemblies must be installed to allow access for testing and repair. Vertical installation should only be used if horizontal installation is not feasible and upon approval of the water purveyor. The assembly must also be certified effective by the manufacturer if installed in the vertical position.

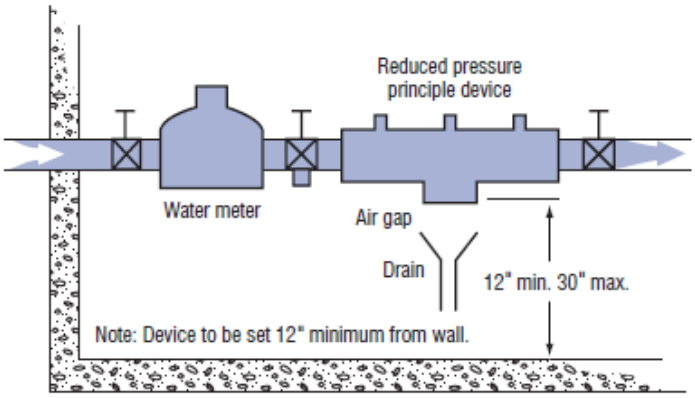

Figure A-1. Horizontal installation of a reduced pressure principle backflow prevention assembly. The clearance dimensions indicated are recommended to provide access for testing and repair.

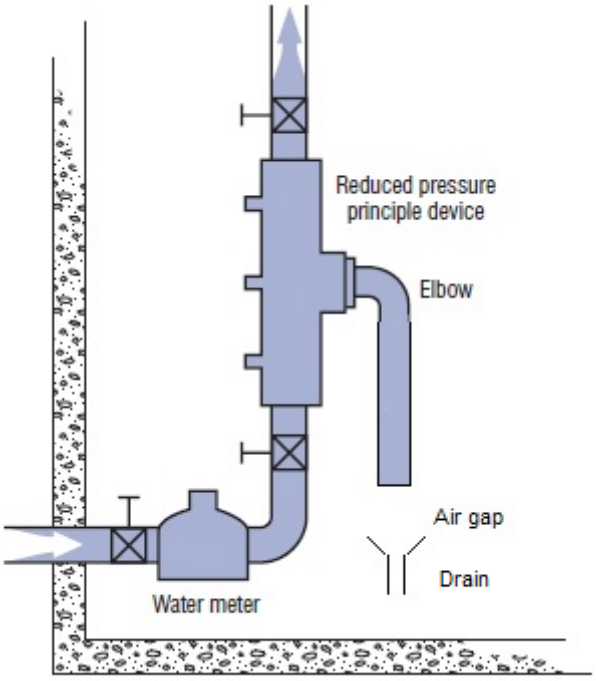

Figure A-2. Vertical installation of a reduced pressure principle backflow prevention assembly.

TEST GAUGES

A differential pressure gauge is required for testing reduced pressure backflow prevention assemblies and the newer type pressure vacuum breakers (which utilize springs for the air inlet and check valve) and also is used to test double check valve assemblies. A single pressure gauge is required for testing low suction pressure cut-off controllers and minimum pressure sustaining valves.

Differential pressure gauges measure the difference in pressure between two points in the system. The range of these gauges is usually limited to 15 psid (pounds per square inch differential), therefore they cannot be used to measure line pressure. They usually are of the balanced diaphragm type which contains a pressure differential diaphragm and a magnetic drive, and are protected from excess or reverse pressure by drive stops.

A variety of pre-assembled test kits are available from a number of manufacturers. These test kits differ in the connections and needle valves provided, which may require some adjustment of the test procedures outlined in this appendix. It is important that the tests be thoroughly understood before any such adjustments are made.

Only high quality, calibrated gauges may be used. It is recommended that filter/strainers be used on all of the connecting hoses. A variety of adapter fittings are required for attaching the connector hoses to the test cocks of the various sizes of backflow prevention assemblies.

The test gauges are precision instruments and must be treated with care. The needle valves must be closed only finger tight or they may be irreparably damaged and have to be replaced. The gauges must be drained after each use and all valves left in the open position. Prior to the start of each test, all valves on the gauges should then be closed.

The gauges most commonly used to test backflow preventers are the three valve and five valve types of a pressure differential gauge. The gauge indicates pressure in pounds and two tenths of a pound as pounds per square inch differential or psid.

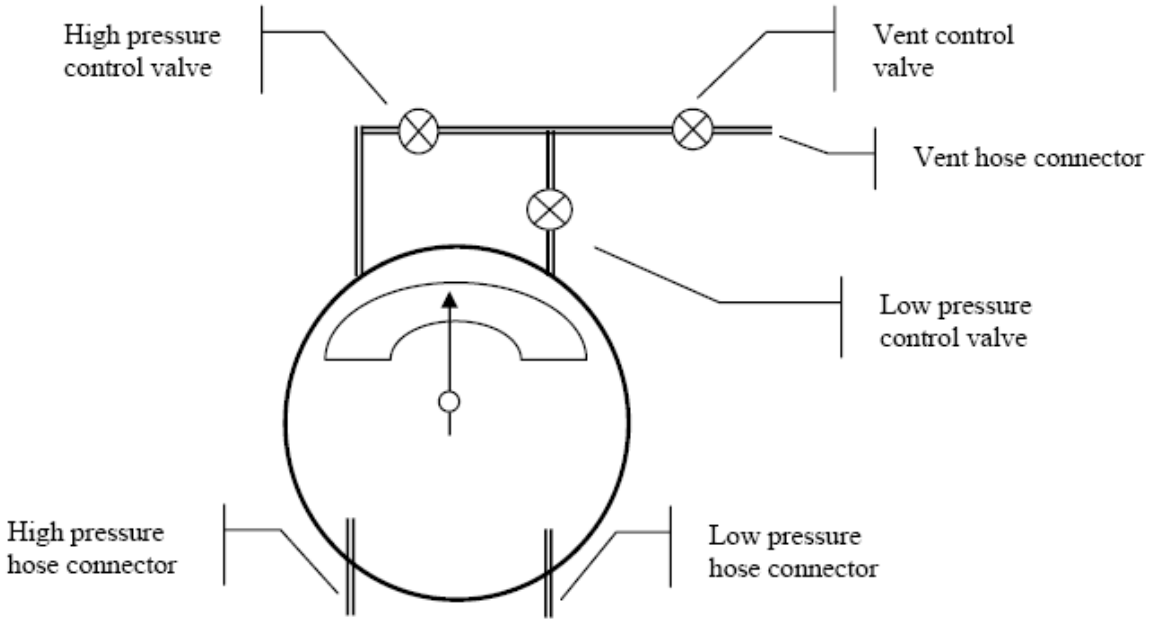

Figure A-3. Schematic of three valve test gauge.

Figure A-3 provides an illustration of the components of the three-valve test gauge as used in the test procedures provided on pages 124 to 143.

The five-valve analog gauge works exactly the same as the three-valve analog gauge. It compares the difference between two pressures and the gauge needle indicates the difference between the two pressures. However, due to the additional valves, the test steps are slightly different although the test procedures are exactly the same.

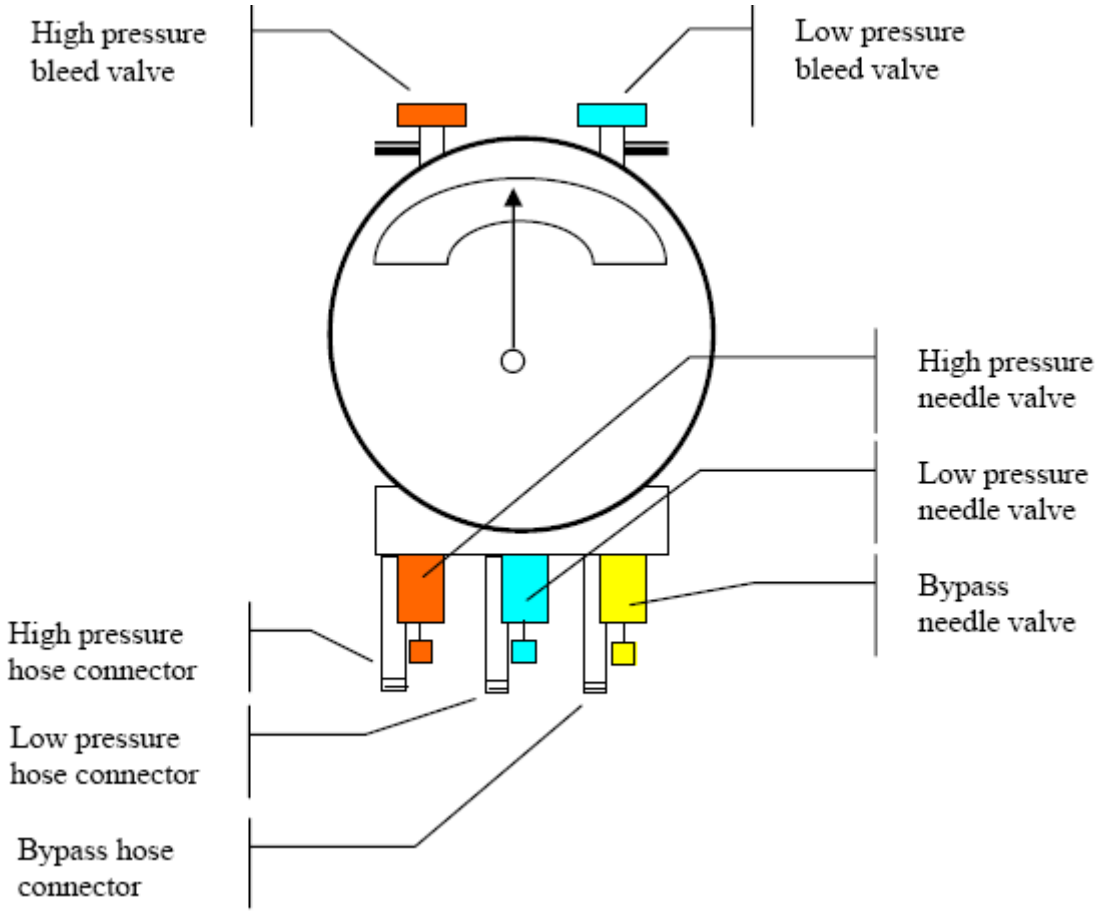

Figure A-4. Schematic of five valve test gauge.

Figure A-4 provides an illustration of the components of the five-valve test gauge as used in the test procedures on pages 124 to 143.

Other test devices have been used to test backflow prevention assemblies, such as the combination bourdon test gauges or duplex gauge. Their use is still acceptable provided the tester understands the methodology to properly apply the test methods when using these test devices.

The test procedures provided in this manual for the pressure vacuum breaker, the double check valve assembly and the reduced pressure principle backflow prevention assembly reference the use of either the three valve or five valve differential pressure test gauge.

AIR GAP SEPARATION

Equipment Required

A measuring tape to ascertain whether the air gap is properly installed.

Requirements

1. Air gap separations shall be inspected at the time of installation and at least every twelve months thereafter by an inspector approved by the supplier of water.

2. They shall not be bypassed, or otherwise made ineffective.

3. All defects found during inspection of the air gap shall be satisfactorily corrected without delay.

Inspection Procedure

1. Determine that the air gap separation provides the required minimum air gap.

2. Confirm that the air gap separation is not being bypassed.

The following form is a suggested method to record and report on the inspection of an air gap.

Report on Inspection

AIR GAP SEPARATION

Location of Device _____

Date Installed _____ Service No. _____

I hereby certify that the air gap separation described above was inspected by me on _____ and the following findings were made:
(date)

_____ Effective diameter of the supply pipe or opening.

_____ Near wall distance, if present.

_____ Height of supply opening above the flood-level rim.

_____ _____ Required minimum air gap separation is provided.
Yes No

_____ _____ Air gap separation is not being bypassed.
Yes No

_____ _____ No evidence that arrangements have been made to bypass
Yes No the air gap separation.

Inspector _____ _____
(signature) (printed name)

CERTIFICATION

I hereby certify that the foregoing report is correct and that the following statement is true:

The air gap separation has been in constant use at the location during the entire prescribed interval between inspections and during that period this device was not bypassed or otherwise made ineffective.

Company _____ Signature _____

Address _____ Print Name _____

_____ Title _____

Date _____

VACUUM BREAKERS

Requirements

1. Pressure vacuum breakers shall be routinely inspected at least every three months by the owner for visible conditions which would or could prevent the normal functioning of the device.

2. They shall be inspected and tested for capability to prevent backsiphonage at the time of installation and at least every twelve months thereafter by an inspector approved by the regulatory agency and/or the supplier of water whenever needed and at least every twelve months.

3. A complete record of each device must be maintained by the owner. This shall include a comprehensive listing from purchase to retirement of all inspections, tests and repairs.

4. They shall not be bypassed, made inoperative or removed without proper authorization.

5. All defects found during inspection, testing or overhaul of the devices shall be satisfactorily corrected without delay.

Routine Inspection Procedure

1. Observe for signs of water leaks from the vent ports. Water marks or other surface stains on the outside of the body would indicate leaking and possible malfunctioning of the device.

2. Inspect for conditions that would prevent normal functioning of the device. Cloth or other material may be wrapped around the device, covering the vent ports. The vent closing mechanism may be locked in closed position by some mechanical means that could only be revealed by removing the hood or bonnet of the vacuum breaker.

3. Determine that the device is not subjected to backpressure under any conceivable condition. Boilers, elevated storage tanks, pumps or other pressure producing systems could cause the device to be subjected to backpressure.

4. Inspect for proper location and position in the water system. Pressure vacuum breakers must be located at a high point, at least twelve inches above the flood or overflow levels of all equipment or outlets being supplied.

5. Determine that the device has not been removed without proper authorization.

Field Test Procedure – Pressure Type

The field test for pressure type vacuum breakers is intended to test the capability of the device to prevent backsiphonage. The procedure for testing is as follows:

Internal Inspection Procedure for Pressure Vacuum Breaker

1. Inspect the valve seats for scoring or dirt accumulation which could result in leakage through the air inlet valve. The valve discs should also be checked for cracking or other indications of imperfections.

2. Observe the internal parts for any accumulation of foreign matter which could cause malfunctioning. Check to see that the guides are not fouled and that the port flow areas are not filled.

Field Test Procedure Using Three Valve Gauge for Pressure Vacuum Breaker

SETUP

a. Install hose adapters and flush test cocks #1 and #2
b. Close all control valves on test equipment
c. Remove the air inlet canopy

TEST 1: Purpose: To test Air Inlet Valve
Requirements: The Air Inlet Valve must open when the pressure in the valve body drop to 1.0 psig above atmospheric pressure, and the air inlet valve must open fully when all of the water has drained from the valve body.

Note: It is important that the test gauge be positioned at the same elevation as the vacuum breaker during test #1 in order to eliminate any effect from a water column created in the hose.

PROCEDURE

a. Connect the high pressure hose to test cock #2
b. Slowly open test cock #2 so that you do not slam the gauge needle
c. Open the high pressure control valve
d. Open the vent control valve to bleed any air from the hose and gauge
e. Close the vent control valve
f. Close Shut-Off Valve #2
g. Close Shut-Off Valve #1
h. Slightly open the low control valve to allow the water pressure in the body of the pressure vacuum breaker to fall slowly while observing the pressure differential gauge.

   You may touch (but do not push) the air inlet valve to feel for the first movement as it opens; in a quiet area you can hear the air inlet valve open.

i. Record the pressure differential, at which the air inlet valve opened, on the test form. The gauge reading at the point of opening must be 1 psig or greater for the air inlet valve to pass

j. Close the low pressure control valve
k. Close test cock #2 and disconnect the hose
l. Open Shut-off Valve #1 quickly in order to reseat the air inlet valve and re-pressurize the assembly

CONTINUE TO TEST 2

Field Test Procedure Using Three Valve Gauge for Pressure Vacuum Breaker

TEST 2: Purpose: To test the Check Valve

Requirements: The Check Valve must be drip-tight in the normal direction of flow when the inlet pressure is 1.0 psig and the outlet pressure is atmospheric

PROCEDURE

a. Connect the high pressure hose to test cock #1
b. Slowly open test cock #1 so that you do not slam the gauge needle
c. Open the vent control valve to bleed any air from the hose and gauge
d. Close the vent control valve
e. Close Shut-off Valve #1
f. Fully open test cock #2.

   This will drain the water from the body of the vacuum breaker and open the air inlet valve. When the flow from the test cock #2 stops, lift the gauge to place pressure against the check valve in the direction of flow. The pressure reading indicated on the gauge will be pressure drop across the check valve.

g. Record the gauge reading on test form.
   The gauge reading must be 1 psig or greater for the check valve to pass.

h. Close test cocks #1 and #2, then disconnect the hose
i. Open Shut-off Valve #1 quickly in order to seat the air inlet valve and re-pressurize the assembly
j. Open Shut-off Valve #2
k. Re-install the air inlet canopy
l. Open all of the control valves to drain the water in the gauge
m. Remove the hose adapters
n. Make sure that the water is back on to the building

-END OF TEST PROCEDURE-

Field Test Procedure Using Five Valve Gauge

ASSE 1020 Pressure Vacuum Breaker

SETUP

a. Install hose adapters and flush test cocks #1 and #2
b. Connect the high, low and bypass hoses to the gauge
c. Close all control valves on test equipment
d. Remove the air inlet canopy

TEST 1: Purpose: To test Air Inlet Valve
Requirements: The Air Inlet Valve must open when the pressure in the valve body drop to 1.0 psig above atmospheric pressure, and the air inlet valve must open fully when all of the water has drained from the valve body.

Note: It is important that the test gauge be positioned at the same elevation as the vacuum breaker during test #1 in order to eliminate any effect from a water column created in the hose.

PROCEDURE

a. Connect the high pressure hose to test cock #2
b. Open the high pressure bleed valve
c. Slowly open test cock #2 so that you do not slam the gauge needle
d. Close the high pressure bleed valve
e. Close Shut-Off Valve #2
f. Close Shut-Off Valve #1
g. Slightly open the high pressure bleed valve to allow the water pressure in the body of the pressure vacuum breaker to fall slowly while observing the pressure differential gauge.

   You may touch (but do not push) the air inlet valve to feel for the first movement as it opens; in a quiet area you can hear the air inlet valve open.

h. Record the pressure differential, at which the air inlet valve opened, on the test form. The gauge reading at the point of opening must be 1 psig or greater for the air inlet valve to pass

i. Close test cock #2 and disconnect the hose
j. Open Shut-off Valve #1 quickly in order to reseat the air inlet valve and re-pressurize the assembly

CONTINUE TO TEST 2

Field Test Procedure Using Five Valve Gauge

ASSE 1020 Pressure Vacuum Breaker

TEST 2: Purpose: To test the Check Valve

Requirements: The Check Valve must be drip-tight in the normal direction of flow when the inlet pressure is 1.0 psig and the outlet pressure is atmospheric

PROCEDURE

a. Connect the high pressure hose to test cock #1
b. Open the high pressure bleed valve
c. Slowly open test cock #1 so that you do not slam the gauge needle
d. Close the high pressure bleed valve
e. Close Shut-off Valve #1
f. Fully open test cock #2.

   This will drain the water from the body of the vacuum breaker and open the air inlet valve. When the flow from the test cock #2 stops, lift the gauge to place pressure against the check valve in the direction of flow. The pressure reading indicated on the gauge will be the pressure drop across the check valve.

g. Record the gauge reading on the test form.
   The gauge reading must be 1 psig or greater for the check valve to pass.

h. Close test cocks #1 and #2, then disconnect the hose
i. Open Shut-off Valve #1 quickly in order to seat the air inlet valve and re-pressurize the assembly
j. Open Shut-off Valve #2
k. Re-install the air inlet canopy
l. Open all of the control valves to drain the water in the gauge
m. Remove the hose adapters
n. Make sure that the water is back on to the building

-END OF TEST PROCEDURE-

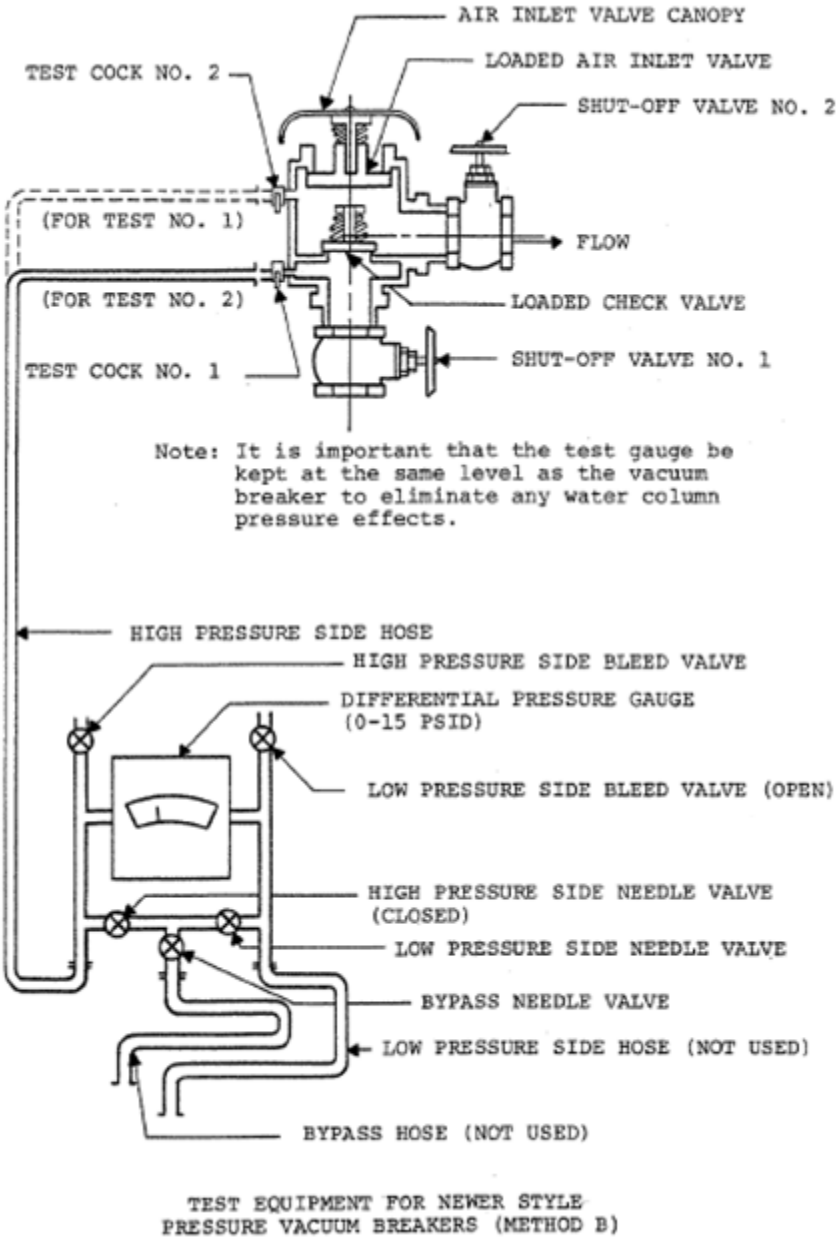

Figure A-5. Five Valve Gauge Test Equipment for Pressure Vacuum Breakers

DOUBLE CHECK VALVE ASSEMBLY

Requirements

1. Double check valve assemblies shall be inspected and tested for tightness at the time of installation and at least every twelve months thereafter by an inspector approved by the supplier of water.

2. A complete record of each device must be maintained by the owner. This shall include a comprehensive listing from purchase to retirement of all tests, inspections, and repairs.

3. They shall not be bypassed, made inoperative, or removed without proper authorization.

4. All defects found during inspection, testing and overhaul of the device shall be satisfactorily corrected without delay.

Routine Inspection Procedure

1. Determine that the double check valve assembly has been installed in accordance with approved plans and that it has not been relocated, removed, or bypassed without proper notification or authorization.

Field Test Procedures

- Equipment Required:

  1 Pressure differential gauge
  3 lengths of 1/4 inch high pressure hose with screw type couplings.
  4 adapter fittings, 1/4 inch IPS by hose, brass.
  4 IPS adapter fittings, 1/4 inch by test cock size, brass.

Field Test Procedure Using Three Valve Gauge for Double Check Valve Assembly

SETUP

a. Install hose adapters and flush test cocks #1, #2, #3, #4
b. Close all control valves on gauge
c. Close shut-off valve #2

TEST 1: Purpose: To test Shut-Off Valve #2
Requirements: Shut-off Valve #2 must be drip-tight in order to obtain accurate results for Tests #2 and #3

PROCEDURE

a. Connect the high pressure hose to test cock #1
b. Connect the low pressure hose to test cock #4
c. Open test cock #1 then open test cock #4
d. Open the high control valve
e. Open the vent control valve to bleed any air from the hose and gauge
f. Close the high control valve
g. Open the low control valve to bleed any air from the hose and gauge, do not close low control valve
h. Close the vent control valve
i. Close the Shut-off valve #1
j. Open the high control valve
k. Observe the gauge reading, it should be zero (0 psi)

If the needle on the gauge remains zero, record Shut-off Valve #2 as holding tightly

If the needle on the gauge rises above zero, record Shut-off Valve #2 as leaking and it must be repaired before you can continue the test. A reading above zero is an indication that there is a pressure head loss through the gauge as the water flows past the leaking Shut-off Valve #2.

l. Open a fixture downstream of Shut-off Valve #2 to create a flow and accurately determine if Shut-off Valve #2 is holding tightly.
m. Close all control valves on the gauge
n. Close test cocks #1 and #4 and disconnect the low and high pressure hoses
o. Open Shut-off Valve #1

CONTINUE TO TEST 2 AND 3

Field Test Procedure Using Three Valve Gauge for Double Check Valve Assembly

TEST 2: Purpose: To test Check Valve #1
Requirements: Check Valve #1 must create a pressure differential of at least 1 psid

PROCEDURE

a. Verify that all control valves and Shut-off Valve #2 are closed
b. Connect the high pressure hose to test cock #2
c. Connect the low pressure hose to test cock #3
d. Open test cock #3 then open test cock #2
e. Open the high pressure control valve
f. Open the vent control valve to bleed any air from the hose and gauge
g. Close the high pressure control valve
h. Open the low pressure control valve to bleed any air from the hose and gauge
i. Close the low pressure control valve
j. Close the vent control valve
k. Observe and record the gauge reading on the test form.
   The gauge reading must be 1 psid or greater for the check valve #1 to pass. If the gauge needle reads less than 1 psid or continues to drop toward zero, then record check valve #1 as fail
l. Close test cocks #2 and #3 and disconnect the low and high pressure hoses.

TEST 3: Purpose: To test Check Valve #2
Requirements: Check Valve #2 must create a pressure differential of at least 1 psid

PROCEDURE

a. Connect the high pressure hose to test cock #3
b. Connect the low pressure hose to test cock #4
c. Open test cock #4 then open test cock #3
d. Open the high pressure control valve
e. Open the vent control valve to bleed any air from the hose and gauge
f. Close the high pressure control valve
g. Open the low pressure control valve to bleed any air from the hose and gauge
h. Close the low pressure control valve
i. Close the vent control valve
j. Observe and record the gauge reading on the test form

   The gauge reading must be 1 psid or greater for the check valve #2 to pass. If the gauge needle reads less than 1 psid or continues to drop toward zero, then record check valve #2 as fail

k. Close test cocks #3 and #4 and disconnect the low and high pressure hoses
l. Open Shut-off Valve #2
m. Open all the control valves to drain the water in the gauge
n. Remove the hose adapters
o. Make sure the water is back on to the building

-END OF TEST PROCEDURE-

Field Test Procedure Using Five Valve Gauge for Double Check Valve Assembly

SETUP

a. Install hose adapters and flush test cocks #1, #2, #3, #4
b. Connect the high, low and bypass hoses to the gauge
c. Close all control valves on gauge
d. Close shut-off valve #2

TEST 1: Purpose: To test Shut-Off Valve #2
Requirements: Shut-off Valve #2 must be drip-tight in order to obtain accurate results for Tests #2 and #3

PROCEDURE

a. Connect the high pressure hose to test cock #1
b. Connect the low pressure hose to test cock #4
c. Open test cock #4
d. Open the low pressure bleed valve to bleed air from the hose and gauge do not close low pressure control valve
e. Open test cock #1
f. Allow the gauge needle to stabilize, then open the high pressure bleed valve to bleed air from the hose and gauge
g. Close the high pressure bleed valve
h. Close the low pressure bleed valve
i. Close Shut-off Valve #1
j. Open the high pressure needle valve one turn
k. Open the low pressure needle valve one turn
l. Loosen then retighten the hose connection at test cock #4 to bleed air from the gauge manifold
m. Observe the gauge reading, it should be zero (0 psi)

   If the needle on the gauge rises above zero, record Shut-off Valve #2 as holding tightly

   If the needle on the gauge rises above zero, record Shut-off Valve #2 as leaking and it must be repaired before you can continue the test. A reading above zero is an indication that there is a pressure head loss through the gauge as the water flows past the leaking Shut-off Valve #2

n. Open a fixture downstream of Shut-off Valve #2 to create a flow and accurately determine if Shut-off Valve #2 is holding tightly
o. Close all control valves on the gauge
p. Close test cocks #1 and #4 and disconnect the low and high pressure hoses
q. Open Shut-off Valve #1

CONTINUE TO TEST 2 & 3

Field Test Procedure Using Five Valve Gauge for Double Check Valve Assembly

TEST 2: Purpose: To test Check Valve #1
Requirements: Check Valve #1 must create a pressure differential of at least 1 psid

PROCEDURE

a. Verify that all control valves and Shut-off Valve #2 are closed
b. Connect the high pressure hose to test cock #2
c. Connect the low pressure hose to test cock #3
d. Open test cock #3
e. Open the low pressure bleed valve to bleed air from the hose and gauge
f. Open test cock #2
g. Allow the gauge needle to stabilize, then open the high pressure bleed valve to bleed air from the hose and gauge
h. Close the high pressure bleed valve
i. Close the low pressure bleed valve
j. Observe and record the gauge reading on the test form.

   The gauge reading must be 1 psid or greater for the check valve #1 to pass. If the gauge needle reads less than 1 psid or drops toward zero, then record check valve #1 as fail

k. Close test cocks #2 and #3 and slowly bleed the gauge pressure though the bleed valves

---

TEST 3: Purpose: To test Check Valve #2
Requirements: Check Valve #2 must create a pressure differential of at least 1 psid

PROCEDURE

a. Connect the high pressure hose to test cock #3
b. Connect the low pressure hose to test cock #4
c. Open test cock #4
d. Open the low pressure bleed valve to bleed air from the hose and gauge
e. Open test cock #3
f. Allow the gauge needle to stabilize, then open up the high pressure bleed valve to bleed air from the hose and gauge
g. Close the high pressure bleed valve
h. Close the low pressure bleed valve
i. Observe and record the gauge reading on the test form

The gauge reading must be 1 psid or greater for the check valve #2 to pass. If the gauge needle reads less than 1 psid or drops toward zero, then record check valve #2 as fail

j. Close test cocks #3 and #4 and slowly bleed the gauge pressure from the bleed valves
k. Open Shut-off Valve #2
l. Open all the control valves to drain the water in the gauge
m. Remove the hose adapters
n. Make sure the water is back on to the building.

-END OF TEST PROCEDURE-

Internal Inspection Procedure (When necessary)

1. Never dismantle more than one valve nor have more than one unit out of service at one time.

2. Clean the inside of the valves thoroughly. Remove the poppet or the hinge pin and clapper and clean them. Inspect the test cocks and gauge connections and see that sediment and rust are removed.

3. Wash the elastomer valve facing ring and replace it if it is damaged or has lost its resiliency. See that the seat is smooth and clean. Have a spare facing ring on hand.

4. Replace the poppet or clapper. See that it seats tight and that the poppet or clapper is entirely free and capable of opening wide. A good fitting valve will make a hollow sound when the poppet or clapper is lifted slightly and dropped onto the seat.

5. A new gasket is usually required for the valve cover. Have one on hand when making an inspection.

6. After cleaning both valves make the regular test for tightness.

7. Finally, expel air from valves, restore pressure, and be sure to leave both shut-off valves open.

Note: The proper equipment and considerable skill and care are required when disassembling/assembling the larger devices to avoid injury to the mechanic(s) or damage to the device. Spring loadings or clapper weights can exceed 100 pounds.

Lubricants should not be necessary for proper operation of the device, but may be sparingly used to aid in assembly. Only food grade lubricants or a pharmaceutical grade mineral oil may be used.

REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTION ASSEMBLY

Requirements

1. Reduced pressure principle backflow prevention assemblies shall be inspected and tested for tightness and proper operation at the time of installation and at least every twelve months thereafter by an inspector approved by the supplier of water.

2. A complete record of each device must be maintained by the owner. This shall include a comprehensive listing from purchase to retirement of all tests, inspections and repairs.

3. They shall not be bypassed, made inoperative or removed without proper authorization.

4. All defects found during inspection, testing, or overhaul of the device shall be satisfactorily corrected without delay.

It is recommended that the owner observe the assembly at least twice a week for evidence of leakage through the relief valve and routinely inspect the backflow preventer every three months.

Routine Inspection Procedure

1. Look for signs of leakage from the relief valve port.

2. Inspect for conditions which could prevent normal functioning of the device. The opening of the relief valve port should be examined to ascertain that it has not been plugged.

3. Determine that the device has been properly installed above ground or floor level, whichever is higher, and that it is protected from freezing.

4. Observe that any discharge from the relief valve port would be visible and that the relief valve port is not directly connected to a sewer.

Field Test Procedure Using Three Valve Gauge for Reduced Pressure Principle Backflow Prevention Assembly

---

SETUP

a. Install hose adapters and flush test cocks #2, #3, #4
b. Close all control valves on the test gauge
c. Close shut-off valve #2

TEST 1: Purpose: To test Check Valve #1
Requirements: Check Valve #1 must indicate a pressure differential equal to or greater than 5 psid to continue the test

PROCEDURE

a. Connect the high pressure hose to test cock #2
b. Connect the low pressure hose to test cock #3
c. Open test cock #3
d. Open test cock #2
e. Open the vent control valve on the gauge
f. Open the high pressure control valve to bleed any air from the hose and gauge
g. Close the high pressure bleed valve
h. Open the low pressure control valve to bleed any air from the hose and gauge
i. Close the low pressure bleed valve
j. Observe the gauge to verify that Check Valve #1 is creating a minimum pressure differential equal to or greater than 5 psid in order to continue the test. Record the reading on the test form.

TEST 2: Purpose: To test Pressure Differential Relief Valve
Requirements: The Relief valve must maintain a pressure differential of at least 2 psid between the Relief Valve Zone and the supply pressure

PROCEDURE

a. Close the vent control valve
b. Open the high pressure control valve
c. Slightly open the low pressure control valve to slowly increase the water pressure in the intermediate pressure zone, the gauge needle should begin to drop toward zero and observe when water first begins to discharge from the relief port.
d. Observe the gauge reading at which this discharge is first occurring and record the psid reading shown on the gauge.
e. Record the Relief Valve as passed if water discharged at 2 psid or greater

f. Compare the gauge reading obtained for Check Valve #1 and the Relief Valve. The Check Valve #1 psid must be 3 psi or greater than the Relief Valve psid for the Check Valve #1 to pass
g. Close the high and low pressure control valves

CONTINUE TO TEST 3 & 4

TEST 3: Purpose: To test Check Valve #2
Requirements: Check Valve #2 must hold tightly against backpressure

PROCEDURE

a. Open the vent control valve
b. Open the high pressure control valve to bleed any air from the hose and gauge
c. Close the high pressure control valve
d. Open the low pressure control valve to bleed any air from the hose and gauge
e. Close the low pressure control valve
f. Connect the vent hose to test cock #4
g. Open the high pressure control valve
h. While observing the gauge, open test cock #4

The gauge needle may drop slightly then should remain static if Check Valve #2 is holding tightly. If the gauge needle continues to drop downward and the relief valve starts to discharge water then Check Valve #2 is leaking.

i. Record Check Valve #2 as either pass or fail on the test form

---

TEST 4: Purpose: To test Shut-off Valve #2
Requirements: Shut-off Valve #2 must be drip-tight in order to obtain accurate test readings

PROCEDURE

a. While observing the gauge, close test cock #2

The gauge needle may drop slightly then should remain static if Shut-off Valve #2 is drip-tight. If the gauge needle continues to drop toward zero, then Shut-off Valve #2 is leaking

b. Open a fixture downstream of Shut-off Valve #2 to create a flow and accurately determine if Shut-off Valve #2 is holding tightly

c. Record Shut-off Valve #2 as pass or fail on the test form

Note: If Shut-off valve #2 is leaking, then you must repair or replace the valve and repeat all tests

d. Open Shut-off valve #2
e. Close all test cocks
f. Remove the high, low, and vent pressure hoses
g. Open all control valves to drain the test gauge
h. Remove the hose adapters from the test cocks
i. Make sure that the water is on to the building

-END OF TEST PROCEDURE-

Field Test Procedure Using Five Valve Gauge for Reduced Pressure Principle Backflow Prevention Assembly

---

SETUP

a. Install hose adapters and flush test cocks #2, #3, #4
b. Close all control valves on the test gauge
c. Close shut-off valve #2

TEST 1: Purpose: To test Check Valve #1
Requirements: Check Valve #1 must indicate a pressure differential equal to or greater than 5 psid to continue the test

PROCEDURE

a. Connect the high pressure hose to test cock #2
b. Connect the low pressure hose to test cock #3
c. Open test cock #3
d. Open the low pressure bleed valve to bleed air from the hose and gauge do not close low pressure bleed valve
e. Open test cock #2
f. Wait for the needle to stabilize, then open the high pressure bleed valve to bleed air from the hose and gauge
g. Close the high pressure bleed valve
h. Close the low pressure bleed valve
i. Observe the gauge to verify that Check Valve #1 is creating a minimum pressure differential equal to or greater than 5 psid in order to continue the test. Record the reading on the test form.

TEST 2: Purpose: To test Pressure Differential Relief Valve
Requirements: The Relief valve must maintain a pressure differential of at least 2 psid between the Relief Valve Zone and the supply pressure

PROCEDURE

a. Open the high pressure needle valve
b. Slightly open the low pressure control valve to slowly increase the water pressure in the intermediate pressure zone, the gauge needle should begin to drop toward zero and observe when water first begins to discharge from the relief port.
c. Observe the gauge reading at which this discharge is first occurring and record the psid reading shown
d. Record the Relief Valve as passed if water discharged at 2 psid or greater

e. Compare the gauge readings obtained for Check Valve #1 and the Relief Valve. The Check Valve #1 psid must be 3 psi or greater than the Relief Valve psid for the Check Valve #1 to pass.
f. Close the high and low pressure control valves.

CONTINUE TO TEST 3 & 4

TEST 3: Purpose: To test Check Valve #2
Requirements: Check Valve #2 must hold tightly against backpressure

PROCEDURE

a. Loosely connect the bypass hose to test cock #4
b. Open the bypass needle valve to bleed air from the bypass hose, then tighten the fitting at test cock #4
c. Slightly open then close the low pressure bleed valve to reestablish the normal differential pressure
d. While observing the gauge, open test cock #4 to put high pressure behind check valve #2

   The gauge needle may drop slightly then should remain static if Check Valve #2 is holding tightly. If the gauge needle continues to drop downward and the relief valve starts to discharge water then Check Valve #2 is leaking.

e. Record Check Valve #2 as either pass or fail on the test form.

TEST 4: Purpose: To test Shut-off Valve #2
Requirements: Shut-off Valve #2 must be drip-tight in order to obtain accurate test readings

PROCEDURE

a. While observing the gauge, close test cock #2

   The gauge needle may drop slightly then should remain static if Shut-off Valve #2 is drip-tight. If the gauge needle continues to drop toward zero, then Shut-off Valve #2 is leaking

b. Open a fixture downstream of Shut-off Valve #2 to create a flow and accurately determine if Shut-off Valve #3 is holding tightly

c. Record Shut-off Valve #2 as pass or fail on the test form

Note: If Shut-off valve #2 is leaking, then you must repair or replace the valve and repeat all tests

d. Open Shut-off valve #2
e. Close all test cocks
f. Remove the high, low, and bypass hoses
g. Open all control valves to drain the test gauge
h. Remove the hose adapters from the test cocks
i. Make sure that the water is on to the building.

-END OF TEST PROCEDURE-

Internal Inspection Procedure (When necessary)

1. Inspect the check valves as outlined in the internal inspection procedure for the double check valve assembly.

2. Clean the insides of the pressure differential relief valve thoroughly.

3. Inspect all internal parts for wear, corrosion, erosion or mineral build-up.

4. Clean or replace all parts as required.

5. Inspect all diaphragms and “o”-rings for wear of damage, and replace as required.

6. After cleaning both check valves and the pressure differential relief valve, make the regular test for tightness.

Note: The proper equipment and considerable skill and care are required when disassembling/assembling the larger devices to avoid injury to the mechanic(s) or damage to the device. Spring loadings or clapper weights can exceed 100 pounds.

Lubricants should not be necessary for proper operation of the device, but may be sparingly used to aid in assembly. Only food grade lubricants or a pharmaceutical grade mineral oil may be used.

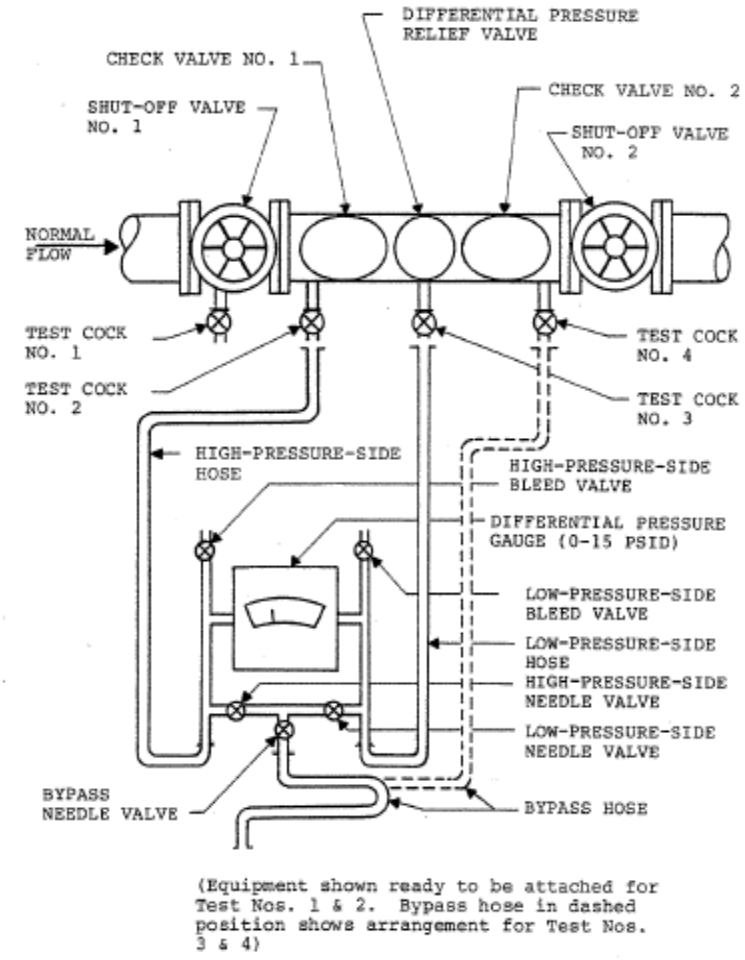

Figure A-6. Five Valve Gauge Test Equipment for Reduced Pressure Principle Backflow Prevention Assemblies

A suggested form to record test results for Pressure Vacuum Breakers, Double Check Valve Assemblies and Reduced Pressure Principle Backflow Prevention Assemblies can be found on the following page.

STATE OF OHIO

Annual Test & Maintenance Report for Backflow Prevention Assemblies

Facility Name: _____

Address: _____ Contact Person: _____

Assembly Information

Make: _____

Model: _____

Size: _____

Serial Number: _____

Installation Information

Containment _ Isolation _

Meter Pit _ Basement _ Floor Number: _____

Penthouse _ Boiler Room _ Room Number: _____

Mechanical Room _ Protection Provided: _____

Double Check Assembly			
Initial Test	Outlet Valve		Pass _ Fail _
	1st Check Valve	___psid	Pass _ Fail _
Date _____	2nd Check Valve	___psid	Pass _ Fail _

Reduced Pressure Assembly		
1st Check Valve	____ psid	Pass _ Fail _
Relief Valve Opening Point	____ psid	Pass _ Fail _
2nd Check Valve		Pass _ Fail _
Outlet Valve	Pass _	Fail _

Pressure Vacuum Breaker		
Air Inlet Valve	___ psig	Pass _ Fail _
Check Valve	___ psig	Pass _ Fail _

Repairs & Materials Used			

Double Check Assembly			
Re-Test After Repairs	Outlet Valve		Pass _ Fail _
	1st Check Valve	___psid	Pass _ Fail _
Date _____	2nd Check Valve	___psid	Pass _ Fail _

Reduced Pressure Assembly		
1st Check Valve	____ psid	Pass _ Fail _
Relief Valve Opening Point	____ psid	Pass _ Fail _
2nd Check Valve		Pass _ Fail _
Outlet Valve	Pass _	Fail _

Pressure Vacuum Breaker		
Air Inlet Valve	___ psig	Pass _ Fail _
Check Valve	___ psig	Pass _ Fail _

Comments:

TESTER CERTIFICATION: *I hereby certify that the above data is correct and that the backflow prevention device is in proper working condition.*

Tester Name (Printed) _____ **Signature** _____

Company Name _____ **Ohio Cert. No.** _____ **Contractor No** _____ **Date** _____

I hereby certify that the above backflow prevention device has been in constant use at this location during the entire prescribed interval between test periods and during that period this device was not bypassed, made inoperative or removed without proper authorization. I further certify that I have the authority and responsibility to ensure the above.

Owner/Officer (Printed) _____ **Signature** _____

Title: _____ **Date:** _____

(DICL3102)Updated 11/11

INTERCHANGEABLE CONNECTION

Requirements

1. Interchangeable connections shall be inspected and their reduced pressure principle backflow prevention assemblies tested for tightness and proper operation at the time of installation and at least every twelve months thereafter by an inspector approved by the supplier of water.

2. They shall not be bypassed, made inoperative, or removed without proper authorization.

3. All defects found during inspection, testing or overhaul of the interchangeable connection shall be satisfactorily corrected without delay.

It is recommended that the reduced pressure principle backflow prevention assembly be routinely inspected by the owner at least every three months and observed for leakage from the relief port at least twice a week in accordance with the procedures given in this appendix (see page 166).

Inspection Procedure

1. Determine that the interchangeable connector and the backflow prevention assembly have been properly installed. A separate stop valve must be installed on each piping connection. An approved reduced pressure principle backflow prevention assembly must be installed on the public water supply pipe supplying the interchangeable connection. There must be a free discharge from the tell-tale port of a four-way valve. No piping should be connected to the tell-tale port.

2. Confirm that the assembly has been installed in accordance with approved plans and that it has not been relocated, removed or bypassed without proper notification or authorization.

3. Test the reduced pressure principle backflow prevention assembly installed as part of the interchangeable connection for tightness and proper operation using the field test procedure given in this appendix (starting on page 167).

The following form is suggested to record and report inspections of interchangeable connections.

INTERCHANGEABLE CONNECTION INSPECTION REPORT FORM

Premises Address:_____ Company Name:_____
Contact Name:_____ Contact Phone No:_____
Location of Interchangeable Connection:_____
Type of Connection: 4-Way_____ Swing_____ Service Number_____ Meter Number_____
Type of Inspection: Initial_____ Annual_____ Date of Inspection:_____

I certify that the interchangeable connection as described above was inspected by me on the date indicated and the following findings were made:

Yes	No	
_____	_____	The interchangeable connection was found to be properly installed in accordance with the requirement of the Ohio Environmental Protection Agency and the plans as approved
_____	_____	The interchangeable connection has not been bypassed removed, or relocated
_____	_____	The reduced pressure principle backflow prevention device, installed as part of this interchangeable connection has been tested for tightness and proper operation (test report attached).

COMMENTS:_____
_____
_____

INSPECTOR: Signature_____ Printed Name_____

Cert. Tester No._____ Date_____

****

I certify that the foregoing inspection was performed on the date indicated and that the following statement is true:

The interchangeable connection as described above has been in uninterrupted use during the entire prescribed interval between inspections and that during that period has not been bypassed or otherwise made ineffective.

Company Representative: (Print Name)_____ Date_____

Signature_____ Title_____

BOOSTER PUMP LOW-SUCTION PRESSURE CUT-OFF CONTROLLER

Requirements

1. Booster pump low-suction pressure cut-off controllers (and minimum pressure sustaining valves, if installed) shall be inspected and tested for proper operation at the time of installation and at least every twelve months thereafter.

2. A complete record of each installation must be maintained by the owner. This shall include a comprehensive listing from purchase to retirement of all tests, inspections and repairs.

3. They shall not be bypassed, made inoperative, or removed without proper authorization.

4. All defects found during inspection, testing or overhaul of the devices shall be satisfactorily corrected without delay.

Inspection Procedure

1. Determine that the device has been properly installed. The suction sensing line must be connected upstream from the booster pump. The minimum pressure sustaining valve, if provided, must be installed downstream from the booster pump. See Figure A-7 for proper installation.

2. Confirm that the device has not been relocated, removed, bypassed or made inoperative without proper notification or authorization.

3. Confirm that the water department seal on the suction pressure sensing line is intact.

Field Test Procedure

- Equipment Required:

  1 Pressure measurement gauge (i.e. bourdon, diaphragm or mechanical pressure gauge)
  1 length of 1/4 inch high pressure hose with screw type couplings.
  1 adapter fitting, 1/4 inch IPS by hose, brass.
  1 IPS adapter fitting, 1/4 inch by test cock size, brass.

  The suction pressure sensing line for the booster pump should be equipped with an isolation valve (with a water department seal) and a test cock.

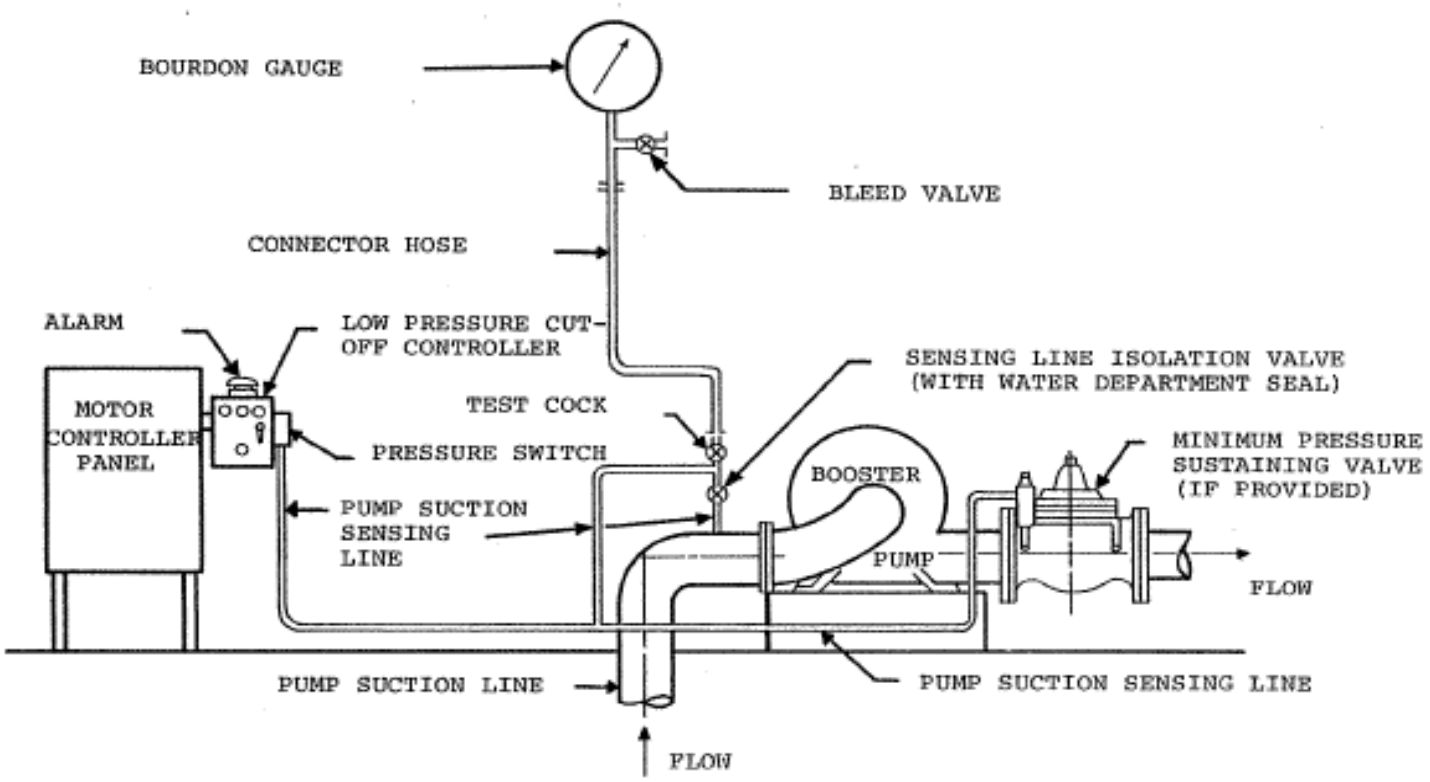

Figure A-7. Test Equipment for Low Suction Pressure Cut-off Devices and Low Suction Throttling Valve and Variable Speed Suction Limiting Control

Test No. 1

Purpose: To test the operation of the low suction pressure cut-off device.

Requirement: The low pressure cut-off device shall operate to shut-off the booster pump within 30 seconds when the pressure in the pump suction sensing line drops to 10 psig or less.

Steps:

a. Open and then close the test cock to flush out any sediment, scale or debris; then attach the adapter fitting.

b. Attach the gauge hose to the test cock.

c. Open the test cock.

d. Bleed the air from the hose and gauge using the bleed valve; then close the bleed valve.

e. Start the booster pump. It may be desirable to have the owner's representative or booster pump tester do this.

f. Remove the water department seal from the isolation valve on the pump suction sensing line and close the isolation valve.

g. Carefully open the bleed valve and slowly lower the pressure in the sensing line to 12 psig; then close the bleed valve and hold this pressure for 30 seconds.

h. Using the bleed valve as in step g, lower the pressure in the sensing line by 1 psi increments until the pump shuts off within 30 seconds.

i. Record the pressure reading at which the pump shuts off. This pressure must be 10 psig or greater.

Test No. 2

Purpose: To test the operation of the low suction throttling valve, if installed.

Requirement: The low suction throttling valve shall operate to maintain the booster pump suction pressure above 10 psig under all flow conditions.

Steps: While performing Test No. 1, above, if the booster pump is equipped with a low suction throttling valve, observe the valve setting indicator to determine if the valve is closing in response to the simulated suction pressure. The low suction throttling valve

should completely close when the pressure in the suction sensing line drops below 10 psig.

Test No. 3

Purpose: To determine if the booster pump is equipped with an automatic reset control.

Requirement: The booster pump shall be manually restarted once it is shut-off by the low pressure cut-off device.

Steps:

a. Reopen the sensing line isolation valve.

b. Observe the pressure gauge to determine that the pressure returns to line pressure.

c. If the pump remains shut-off when the suction sensing line pressure returns to line pressure, the booster pump may be reported as remaining off. If the booster pump restarts automatically, the automatic reset circuits must be removed.

d. Restart the booster pump manually to determine that it is operating normally.

e. Turn off the booster pump and return all motor control circuits to their normal settings.

f. Return all valves to their normal positions.

g. Close the test cock, depressurize the test gauge and remove the hose and adapter fittings.

h. Seal the sensing line isolation valve in the open position.

Test No. 4 FOR FIRE PUMPS ONLY

Purpose: To test the operation of the variable speed suction control, if installed.

Requirement: The variable speed suction control shall operate to maintain the booster pump suction pressure above 10 psig under all flow conditions.

a. Steps: While performing Test No. 1, above, if the booster pump is equipped with the variable speed suction control, observe the pump driver setting indicator to determine if the driver speed is slowing down the pump and decreasing flow output in response to the simulated suction pressure. The variable speed suction

control should reduce the pump speed down to minimum levels per manufacturer as the suction sensing line drops below 10 psig.

b. Reopen the sensing line isolation valve. Observe the pressure gauge to determine that the pressure returns to line pressure.

c. Observe that the booster fire pump returns to operating normally.

d. Turn of the booster pump and return all motor control circuits to their normal settings.

e. Return all valves to their normal positions.

f. Close the test cock, depressurize the test gauge and remove the hose and adapter fittings.

g. Seal the sensing line isolation valve in the open position.

For booster pumps used in fire suppression systems (fire pumps), the backflow prevention methods (assemblies and minimum suction pressure sustaining methods), should be tested upon a completion of the annual forward flow fire pump test, in accordance with State Fire Code and the code's referenced National Fire Protection Association (NFPA) 20 standard. The forward fire flow test ensures that the backflow prevention methods are not interfering with operation of the fire pump (such as valves sticking or malfunctioning), however, the integrity of the backflow assembly to hold during backflow conditions or proper operation of the minimum suction pressure method under low pressure conditions must still be verified.

The following forms are suggested to record and report inspection and test results for the low suction pressure cutoff controller and the minimum pressure sustaining valve installed on booster pumps and fire suppression system booster pumps (fire pumps) and the variable speed suction control on fire pumps. Backflow prevention assemblies must be tested in accordance with their respective test methods outlined in this manual and results recorded on the suggestion form.

TEST REPORT FOR LOW SUCTION PRESSURE CUT-OFF CONTROLLER ON BOOSTER PUMP

Premises Address:_____ Company Name:_____
Contact Name:_____ Contact Phone No:_____
Type of Controller: Fire Pump_____ Domestic Booster Pump_____
Pressure Sustaining Valve_____ Manuf_____
Model Number_____ Serial Number_____
Type of Inspection: Initial_____ Annual_____ Date of Inspection:_____

****

Yes	No	
_____	_____	Found the sensing line seal intact
_____	_____	Found the normal power light (green) on

MANUAL START

_____	_____	Low suction light (red) comes on when suction pressure reaches 10 psig
_____	_____	The alarm sounds after a minimum 30 second delay
_____	_____	The pump shuts off immediately after the low suction pressure alarm sounds
_____	_____	The pump has automatic restart when the sensing line is recharged

AUTOMATIC START

_____	_____	Low suction light (red) comes on when suction pressure reaches 10 psig
_____	_____	The alarm sounds after a minimum 30 second delay
_____	_____	The pump shuts off immediately after the low suction pressure alarm sounds
_____	_____	The pump has automatic restart when the sensing line is recharged

RESET PUMP

_____	_____	Opened outlet valve at pump discharge
_____	_____	Pump restarted in manual start mode
_____	_____	Pump restarted in automatic start mode
_____	_____	Resealed sensing line valve in open position

I certify that the low pressure cut-off controller test as described above was performed by me on the date indicated and the findings were as indicated.

INSPECTOR: Signature_____ Printed Name_____

Cert. Tester No._____ Date_____

****

I certify that the inspection was performed on the date indicated and that the following statement is true: The low suction pressure cut-off controller has been in uninterrupted use during the interval between inspections and during that period has not been bypassed or otherwise made ineffective.

Company Representative: (Print Name)_____ Date_____

Signature_____ Title_____

TEST REPORT FOR LOW SUCTION THROTTLING VALVE ONLY ON BOOSTER OR FIRE PUMP

Premises Address:_____ Company Name:_____
Contact Name:_____ Contact Phone No:_____
Type of Controller: Fire Pump_____ Booster Pump___
Throttling Valve_____ Manuf_____
Model Number_____ Serial Number_____
Type of Inspection: Initial_____ Annual_____ Date of Inspection:_____

****

Yes	No	
_____	_____	Found the sensing line seal intact
_____	_____	Found the normal power light (green) on

MANUAL or AUTOMATIC START

_____	_____	Low suction throttling valve indicator showing valve closing to throttle flow and throttling action free from abnormalities
_____	_____	Low suction throttling valve indicator shows closed position at 10 psig
_____	_____	The throttling valve opens fully when the sensing line is recharged and return to full flow is free from abnormalities.

RESET PUMP

_____	_____	Opened outlet valve at pump discharge
_____	_____	Pump restarted in manual start mode
_____	_____	Pump restarted in automatic start mode
_____	_____	Resealed sensing line valve in open position

I certify that the low suction throttling valve test as described above was performed by me on the date indicated and the findings were as indicated.

INSPECTOR: Signature_____ Printed Name_____

Cert. Tester No._____ Date_____

****

I certify that the inspection was performed on the date indicated and that the following statement is true: The low suction throttling valve has been in uninterrupted use during the interval between inspections and during that period has not been bypassed or otherwise made ineffective.

Company Representative: (Print Name)_____ Date_____

Signature_____ Title_____

TEST REPORT FOR VARIABLE SPEED SUCTION LIMITING CONTROL ONLY ON BOOSTER FIRE PUMP

Premises Address:_____ Company Name:_____
Contact Name:_____ Contact Phone No:_____
Type of Controller: Fire Pump_____
Speed Control System (Min Speed)_____Manuf_____
Model Number_____ Serial Number_____
Type of Inspection: Initial_____ Annual_____ Date of Inspection:_____

****

Yes	No	
_____	_____	Found the sensing line seal intact
_____	_____	Found the normal power light (green) on

MANUAL or AUTOMATIC START

_____	_____	Variable speed suction limiting control slowed down pump driver to reduce flow and free from abnormalities
_____	_____	Variable speed suction limiting control reduces pump driver speed to minimum rating of manufacturer at 10 psig
_____	_____	The pump operates at normal speed when the sensing line is recharged and return to full flow is free from abnormalities.

RESET PUMP

_____	_____	Opened outlet valve at pump discharge
_____	_____	Pump restarted in manual start mode
_____	_____	Pump restarted in automatic start mode
_____	_____	Resealed sensing line valve in open position

I certify that the variable speed suction limiting control test as described above was performed by me on the date indicated and the findings were as indicated.

INSPECTOR: Signature_____ Printed Name_____

Cert. Tester No._____ Date_____

****

I certify that the inspection was performed on the date indicated and that the following statement is true: The minimum pressure sustaining valve has been in uninterrupted use during the interval between inspections and during that period has not been bypassed or otherwise made ineffective.

Company Representative: (Print Name)_____ Date_____

Signature_____ Title_____

CROSS-CONNECTION CONTROL SURVEY AND ONSITE INVESTIGATION FORMS

The following cross-connection control survey and onsite investigation forms can be useful in accessing cross-connection control and backflow prevention needs for various service connections through the type of water use practices typically seen onsite. These forms can help the purveyor of water's representative to assess typical hazards and document backflow preventers that are in place or the need for them. These forms (except for the residential dwelling form) were taken from the Ohio Department of Commerce, Division of Industrial Compliance's, Manual of Backflow Prevention & Cross-Connection Control.

CROSS-CONNECTION CONTROL SURVEYS

This form is intended for use as a generic survey form:

Company Name:	
Address:	
Type of Business:	
Contact Person:	
Contact Person's Phone Number:	
Meter Number:	
Meter Size:	

Existing Backflow Preventer Installed	Yes	No	Size	Manufacturer	Model	Serial Number	Date Last Tested

HEATING
☐ Forced Air
☐ Electric
☐ Solar
☐ Boiler
☐ Chemically Treated
☐ Make-up Water From City Water
☐ Feed from Chemical Feed Tank
☐ ASSE 1013 Installed at Make-up

KITCHEN	
☐ Dishwasher	☐ ASSE 1001 Installed
☐ Soap Eductor	☐ ASSE 1001 Installed
☐ Garbage Disposal	☐ ASSE 1001 Installed
☐ CO2 Dispenser	☐ ASSE 1032 Installed
☐ Ice Machine	☐ Air-Gap at Drain Line
☐ Hose Bibs	☐ ASSE 1011 Installed
☐ Other	
☐ Other	
☐ Other	

MISC EQUIPMENT	
☐ Hose Bibs	☐ ASSE 1011
☐ Eductor	☐ ASSE 1001
☐ Aspirator	☐ ASSE 1001
☐ Lab Faucet	☐ ASSE 1001
☐ Shampoo Hose	☐ ASSE 1001
☐ Wax Eductor	☐ ASSE 1001
☐ Thermal Expansion Tank	☐ Yes ☐ No
☐ Other	
☐ Other	

COOLING
☐ None
☐ Forced Air
☐ Chiller
☐ Cooling Tower
☐ Chemically Treated
☐ Make-up Water From City Water
☐ Feed from Chemical Feed Tank
☐ ASSE 1013 Installed at Make-up
☐ Air-Gap at Make-up

THERAPY/POOLS/TANKS/RESERVOIRS	
☐ Sitz/ Sonic Bath	☐ ASSE 1001 Installed
☐ Jacuzzi	☐ Air-Gap at Make-Up Line
☐ Whirlpool	☐ Air-Gap at Make-Up Line
☐ Fountain	☐ Air-Gap at Make-Up Line
☐ Irrigation	☐ ASSE 1013 Installed
☐ Comm Laundry	☐ ASSE 1001 Installed
☐ Swimming Pool	☐ ASSE 1013 Installed ☐ Air-Gap at Make-Up Line
☐ Wash, Dip, or Rinse Tanks	☐ Air-Gap at Make-Up Line
☐ Plating or Coolant Tanks	☐ Air-Gap at Make-Up Line
☐ Other	
☐ Other	

AUXILIARY WATER	
☐ Well/Cistern	☐ Yes ☐ No
☐ Tower	☐ Yes ☐ No
☐ Reservoir	☐ Yes ☐ No
☐ Interconnected	☐ Yes ☐ No
☐ 4-Way/Swing	☐ Yes ☐ No

☐ Domestic Pump LPS Serial Num.	☐ With LPS
☐ Fire Pump LPS Serial Num.	☐ With LPS
Backflow Preventer on Fire	☐ No ASSE_____
Model #of Device	
Serial Number	

Comments: _____

_____

Survey by: _____ **Date:** _____

Company: _____ **Company Phone Number:** _____

CROSS-CONNECTION CONTROL SURVEYS

This form is intended for use in a car wash type facility:

Company Name	
Premises address:	
Contact Person:	
Contact Person's Phone Number:	
Meter Number:	
Meter Size:	
Meter Location:	

Existing Backflow Preventer Installed	Yes	No	Size	Manufacturer	Model	Serial Number	Date Last Tested

FACILITY	FIXTURE	Y/N	MIN FIXTURE PROTECTION	Y/N
Car Wash Truck Wash Detailing Shop	Hot water heater		Air gap at T&P valve drain line	
	Soap eductor for wash heads		Vacuum breaker upstream of feed line	
	Wax eductor for wash heads		Vacuum breaker upstream of feed line	
	Utility sink w/ detergent eductor		Vacuum breaker at hose connection or faucet	
	Hose bib		Non-removable vacuum breaker	
	Chemically treated boiler		Reduced pressure assembly on make-up line	
	Chemically treated air conditioning		Reduced pressure assembly on make-up line	
	Drinking Fountains		Air gap & non-self draining	
	Coffee, tea, or hot chocolate machine		Air gap at fill line	
	Sanitary facilities		Air gap at fixtures	
	Recycled wash or rinse reservoir		Air gap at reservoir make-up line	
	Irrigation system		Reduced pressure assembly or Pressure vacuum breaker	
	Murdock type hydrants		Non-self draining if used for sanitary or culinary purposes - Hose bib vacuum breaker if not used for sanitary or culinary purposes	
	Auxiliary water not connected to city water line(tank, reservoir, well, lagoon)		Reduced pressure assembly at water meter	
	Auxiliary water connected to city water line (tank, reservoir, well, lagoon)		Requires Ohio EPA approval; four-way valve or swing connector	
	Backflow preventer, check valve or pressure regulator at meter		Thermal expansion device	
	Other		**SEE THE BACK OF THIS FORM**	

Comments: _____

_____

_____

_____

Survey by: _____ **Date:** _____

Company: _____ **Company Phone Number:** _____

CROSS-CONNECTION CONTROL SURVEYS

This form is intended for use at a medical facility:

Company Name	
Premises address:	
Contact Person:	
Contact Person's Phone Number:	
Meter Number:	
Meter Size:	
Meter Location:	

Existing Backflow Preventer Installed	Yes	No	Size	Manufacturer	Model	Serial Number	Date Last Tested

FACILITY	FIXTURE	Y/N	MIN FIXTURE PROTECTION	Y/N
	Hot water heater		Air gap at T&P valve drain line	
Hospital	Water softening equipment		Air gap or inline vacuum breaker if controlled fill	
Clinic	Chemically treated boiler		Reduced pressure assembly on make-up line to boiler	
Doctor's Office	Chemical feed lines to boiler		Reduced pressure assembly on make-up line to chemical feed reservoirs	
	Chemically treated air conditioning		Reduced pressure assembly on make-up line to chiller or tower	
Dentist's Office	Chemical feed line to air conditioning		Reduced pressure assembly on make-up line to chemical feed reservoirs	
	Potable water booster pump		Low-suction pressure cut-off controller	
	Utility sink w/ detergent dispenser		Vacuum breaker at hose connection or faucet	
	X-ray developing machine		Air gap or reduced pressure assembly	
	Autopsy table		Vacuum breaker on faucet at hydro-aspirator	
	Autopsy room sink		Vacuum breaker if treaded faucet	
	Whirlpool, Sitz Bath, Hydro-Therapy equipment		Air gap at fill line	
	Bedpan washer		Vacuum breaker	
	Gooseneck lab faucets		Laboratory faucet backflow preventer	
	Ice machine & chests		Air gap at drain line	
	Hose bib		Non-removable vacuum breaker	
	Sanitary facilities		Air gap at fixtures	
	Irrigation system		Reduced pressure assembly or PVB	
	Auxiliary water not connected to city water line(tank, reservoir, well, lagoon)		Reduced pressure assembly at water meter	
	Auxiliary water connected to city water line (tank, reservoir, well, lagoon)		Requires Ohio EPA approval; four-way valve or swing connector	
	Other		**SEE THE BACK OF THIS FORM**	

Comments: _____

_____

Survey by: _____ **Date:** _____

Company: _____ **Company Phone Number:** _____

CROSS-CONNECTION CONTROL SURVEYS

This form is intended for use in a restaurant type facility:

Company Name	
Premises address:	
Contact Person:	
Contact Person's Phone Number:	
Meter Number:	
Meter Size:	
Meter Location:	

Existing Backflow Preventer Installed	Yes	No	Size	Manufacturer	Model	Serial Number	Date Last Tested

FACILITY	FIXTURE	Y/N	MIN FIXTURE PROTECTION	Y/N
Restaurant Cafeteria Lunchroom Kitchen Food Processing	Hot water heater		Air gap at T&P valve drain line	
	Detergent feed to dishwasher		Vacuum breaker upstream of feed line	
	Booster heater to dishwasher		Air gap at drain line	
	Dish rinse unit with flex hose		Vacuum breaker or air gap	
	Sink spout detergent eductor		Vacuum breaker	
	Utility sink w/ detergent dispenser		Vacuum breaker at hose connection or faucet	
	Pot & pan washer w/ submerged inlet		Vacuum breaker	
	Garbage disposal w/ direct connection		Vacuum breaker	
	Garbage can washer, submerged jet		Vacuum breaker or rinse line 6" above rim	
	Ice machine & chests		Air gap at drain line	
	Hose bib		Non-removable vacuum breaker	
	Post mix carbonated beverage machine		Dual check w/ atmospheric vent	
	Coffee, tea or hot chocolate machine		Air gap at fill line	
	Chemically treated boiler		Reduced pressure assembly on make-up line	
	Chemically treated air conditioning		Reduced pressure assembly on make-up line	
	Sanitary facilities		Air gap at fixtures	
	Irrigation system		Reduced pressure assembly or Pressure vacuum breaker	
	Murdock type hydrants		Non-self draining if used for sanitary or culinary purposes - Hose bib vacuum breaker if not used for sanitary or culinary purposes	
	Drinking Fountains		Air gap & non-self draining	
	Auxiliary water not connected to city water line(tank, reservoir, well, lagoon)		Reduced pressure assembly at water meter	
	Auxiliary water connected to city water line (tank, reservoir, well, lagoon)		Requires Ohio EPA approval; four-way valve or swing connector	
	Backflow preventer, check valve or pressure regulator at meter		Thermal expansion device	
	Other		**SEE THE BACK OF THIS FORM**	

Comments: _____

_____

Survey by: _____ **Date:** _____

Company: _____ **Company Phone Number:** _____

CROSS-CONNECTION CONTROL SURVEYS

This form is intended for use for a fire protection system:

Company Name	
Premises address:	
Contact Person:	
Contact Person's Phone Number:	
Meter Number:	
Meter Size:	
Meter Location:	

Existing Backflow Preventer Installed	Yes	No	Size	Manufacturer	Model	Serial Number	Date Last Tested

FACILITY	FIXTURE	Y/N	MIN FIXTURE PROTECTION	Y/N
Fire Protection System	Limited area sprinkler (copper)		Check valve	
	Limited area sprinkler (black iron)		Double check valve assembly	
	Fire protection system, wet, no chemicals added		Double check detector check assembly	
	Fire protection system, wet, chemicals added		Reduced pressure detector check assembly	
	Fire protection system, Foamite		Reduced pressure detector check assembly	
	Fire protection system, dry		Check valve on riser prior to pressurized system	
	Fire hydrants, non-self draining		Double check detector check assembly	
	Fire hydrants, self draining		Reduced pressure detector check assembly	
	Antifreeze leg, propylene glycol		Reduced pressure detector check assembly	
	Antifreeze leg, ethylene glycol		Air gap at make-up line	
	Jockey pump only, no chemicals added		Double check detector check assembly	
	Jockey pump only, chemicals added		Reduced pressure detector check assembly	
	Fire protection Booster pump, no chemicals added		Double check detector check assembly & Low-suction pressure cut-off controller	
	Fire protection Booster pump, chemicals added		Reduced pressure detector check assembly & Low-suction pressure cut-off controller	
	Auxiliary water not connected to fire protection system (tank, tower, reservoir, well, lagoon)		Reduced pressure detector check assembly	
	Auxiliary water connected to fire protection system (tank, tower, reservoir, well, lagoon)		Requires Ohio EPA approval; a reduced pressure detector check assembly and a four-way valve or swing connector	
	Other		**SEE THE BACK OF THIS FORM**	

Comments: _____

_____

_____

_____

Survey by: _____ **Date:** _____

Company: _____ **Company Phone Number:** _____

CROSS-CONNECTION CONTROL SURVEYS

This form is intended for use at a residential dwelling:

Owner Name:	
Premises Address:	
Contact Person:	
Contact Phone:	
Meter Number:	
Meter Size:	
Meter Location:	

Existing Containment Backflow Preventer Installed:	YES	NO	Size	Manufacturer	Model	Serial Number	Date Last Tested

	Check box that describes water use at residence:	Indicate type of backflow preventer installed on plumbing system (i.e., dual check, double check assembly, reduced pressure assembly, pressure vacuum breaker, hose bibb vacuum breaker, low pressure cutoff controller, air gap)
	Typical indoor water usage such as bathrooms, household laundry or dishwashing appliances, and outside water faucets/hose bibs.	
	Private well or cistern supplying property	
	Connection to underground lawn sprinkler/irrigation system	
	Connection into fire sprinkler system	
	Connection into a swimming pool or hot tub	
	Connection to a boiler	
	Booster pump	
	Home-based business (if checked, describe):	
	Other	

Comments _____

_____

_____

_____

Survey by: _____ Date: _____

Designee Affiliation: _____ Designee Phone Number: _____

APPENDIX VI
ADDITIONAL GUIDANCE

POLICY ON THE USE OF ANITFREEZE IN FIRE PROTECTION SYSTEMS

The following information is provided as general information and to assist in the protection of a public water supply when an antifreeze solution is required to prevent freezing of fire protection systems:

1. Antifreeze solutions can consist of either a pure glycerine solution, provided the glycerine is of 96.5% United States pharmacopoeia grade, or of food grade propylene glycol base.

2. Propylene glycol plus dipotassium phosphate is acceptable for use as an antifreeze solution. The propylene glycol is the antifreeze component; the dipotassium phosphate functions as a bacterial inhibitor.

3. The antifreeze manufacturers must furnish proof to the water purveyor that the product is of pharmaceutical grade or of food grade quality and that the product contains no harmful or toxic substances.

4. All antifreeze products used in potable water systems shall be approved by the supplier of water prior to use.

5. All fire protection sprinkler systems that contain approved antifreeze solutions (meets all the requirements above), shall have an approved reduced pressure principle backflow prevention device on that leg of the system or on the complete sprinkler system.

6. If a fire protection system contains ethylene glycol based antifreeze, it is considered a severe health hazard and must be separated from the public water supply/consumer's water system by an approved air gap.

GUIDELINES FOR INSTALLATION OF BACKFLOW PREVENTION ASSEMBLIES

The guidelines for the installation of backflow prevention assemblies can be summarized as follows:

1. The assemblies should be installed between 12 and 30 inches above the finished floor. Assemblies installed higher than 30 inches above a floor should be provided with a service platform and access ladder or stairs.

2. The installation of the assembly should allow for at least 12 inches clearance behind the assembly and at least 48 inches of clearance in front of the assemblies.

3. If the assembly is to be installed in the enclosure, the enclosure should have a ceiling height of at least 6.5 feet to allow for standing room while servicing the assembly.

ASSESSING SEVERE HEALTH HAZARDS AND USE OF AIR GAP ISOLATION IN DETERMINING LEVEL OF CONTAINMENT

Ohio EPA regulations require that a severe health hazard be protected by placing an air gap at the point of connection to the public water system. A public water purveyor may determine that the installation of a reduced pressure principle backflow prevention assembly (RP) at the service connection is sufficient mitigation of a severe health hazard if an air gap is also established at the point of isolation of the severe health hazard process. Such a decision would allow water pressure to be maintained to the service connection for other water use practices while isolating the severe health hazard process from the rest of the customer's water system and the public water distribution system. An understanding between the customer and the public water purveyor must be in place such that at the time the containment device, or RP, is tested, a certification that the air gap is still maintained must also be made. Both test results and air gap certification must be submitted to the public water system every 12 months.

For example, when potable water is used to prime waste water pumps which handle sewage at a waste water treatment plant, an air gap at the supply line to the pump would be installed and an RP installed at the service connection. The use of the air gap at the process and RP at the service connection would be satisfactory to mitigate the severe health hazard.

ALTERNATIVE TO THE INSTALLATION OF AN APPROVED BACKFLOW PREVENTION ASSEMBLY ON SERVICE CONNECTIONS WHERE THERE IS AN AUXILIARY WATER SYSTEM

See the following pages for Ohio EPA's Division of Drinking Water Drinking Water Guidance PWS-02-003 and cross-connection control flier.

Ohio Environmental Protection Agency

Alternative to the Installation of an Approved Backflow Preventer on Service Connections Where There is an Auxiliary Water System	Division: DDAGW Number: PWS-02-003 Category: Public Water System-Guidance Status: Final Issued: Oct. 15, 2015

I. PURPOSE

Under paragraph (C)(2) of Ohio Administrative Code (OAC) rule 3745-95-04 public water systems are not required to install an approved backflow preventer on service connections where there is an auxiliary water system on the real property that is owned or under control of the consumer and adjacent to the premises, provided the system satisfies the conditions of paragraphs (C)(2)(a) through (C)(2)(e). This document is intended to provide guidance and implementation materials to assist public water systems in achieving compliance with this alternative requirement. It is intended that utilization of these procedures and materials will result in compliance with the requirements of OAC rule 3745-95-04(C)(2)***; however, they are provided only as guidance and are not intended to limit a public water system from utilizing other means to achieving compliance***.

II. BACKGROUND

OAC rule 3745-95-04 became effective May 1, 2003. It provides an alternative to the requirement to install an approved backflow preventer on service connections to premises that have an auxiliary water system on the real property adjacent to the premises that is owned or under control of the consumer but not part of the premises. The provider of water may choose the alternative requirement at their discretion. However, for the alternative to be permitted the supplier of water must address each of the following items: (a) determine, on a case-by-case basis, that a backflow preventer is not required, taking into consideration conditions that exist on the premises and adjacent real property; (b) require the consumer to sign a cross-connection control agreement that specifies penalties for creating a connection between the public water system and the auxiliary water system; (c) conduct inspections at least every twelve months to ensure there is no connection or means of connection has been created; (d) maintain an inventory of consumers with auxiliary water systems; and (e) develop and implement an education program to inform all consumers served by the public water system of the dangers of cross-connections and how to eliminate them.

Applicable definitions:

"Auxiliary water system" means any water system on or available to the premises other than the public water system. These auxiliary water systems shall include used water or water from a source other than the public water system, such as wells, cisterns or open reservoirs that are equipped with pumps or other prime movers, including gravity.

"Premises" means any building, structure, dwelling or area containing plumbing or piping supplied from a public water system.

"Real property" as used in OAC rule 3745-95-04(C) is intended to mean the land surrounding or adjacent to, the premises and is owned or controlled by the consumer of water.

III. GUIDANCE

1. OAC rule 3745-95-04(C), effective May 1, 2003, states the following:

"(C) The following requirements apply to premises that have an auxiliary water system on the real property that is owned or under control of the consumer and adjacent to the premises.

(1) A physical separation shall be maintained between the public water system or a consumer's water system and the auxiliary water system as required by paragraph (B) of rule 3745-95-02 of the Administrative Code; **and**

(2) An approved backflow prevention device shall be installed on each service connection serving the consumer's water system, unless the supplier of water does all of the following:

(a) Determines, on a case-by-case basis, that the installation of an approved backflow prevention device on a service connection is not required in consideration of factors including, but not limited to, the past history of cross connections being established or re-established on the premises, the ease or difficulty of connecting the auxiliary water system with the public water system on the premises, the presence or absence of contaminants on the property or other risk factors;

(b) Requires the consumer to sign an agreement which specifies the penalties, including those set forth in rule 3745-95-08 of the Administrative Code, for creating a connection between the public water system and the auxiliary water system;

(c) Conducts or causes to be conducted an inspection at least every twelve months to certify that no connection or means of connection has been created between the public water system and the auxiliary water system;

(d) Maintains an inventory of each consumer's premises where an auxiliary water system is on or available to the premises, or on the real property adjacent to the premises; **and**

(e) Develops and implements an education program to inform all consumers served by the public water system about the dangers of cross-connections and how to eliminate cross-connections."

2. Additional guidance documents

To facilitate compliance with OAC rule 3745-95-04(C)(2), four documents have been developed. These documents collectively address all components identified in OAC rule 3745-95-04(C)(2) and are contained as appendixes to this guidance. The supplier of water is encouraged to utilize these materials or equivalent materials in order to develop and implement an acceptable program. Each of the four documents is described below.

1. Annual Survey for Auxiliary Water Systems

This survey form provides a means for evaluating the conditions that exist on the premises and the real property. It is intended to assist in achieving compliance with OAC rule 3745-95-04(C)(2)(a), (c) and (d). This survey form is intended for use by an employee or other person acceptable to the supplier of water when surveying properties with auxiliary water systems. The survey form may be used for both the initial and annual surveys. Public water systems may modify this survey form or develop their own survey to suit their needs as long as all of the information required by OAC rule 3745-95-04(C)(2)(a) is included.

If a backflow preventer is deemed necessary on the service connection, the type of backflow preventer required must be determined by the supplier of water based on the degree of hazard. The consumer has the option of permanently eliminating the auxiliary water system or other potential backflow hazard in lieu of installing a backflow preventer and should be encouraged to do so as the option most protective of public health. The survey should be signed and dated by the person conducting the survey.

In accordance with OAC rule 3745-95-06, annual surveys must be maintained by the supplier of water for at least five years. It is recommended that surveys be maintained by the supplier of water for as long as the backflow prevention method is in effect. This is intended to provide a history of the establishment of cross-connections or other backflow hazards.

2. Recommended Agreement Language

This document was developed to assist the public water system in meeting the requirements of OAC rule 3745-95-04(C)(2)(b). It provides recommended language for the supplier of water to include for a suitable agreement and includes the penalties, as set forth in OAC rule 3745-95-08, for creating a connection between the public water system and the auxiliary water system. Definitions of specific terms should also be included as well as references to any applicable ordinances, policies, rules, regulations or user agreements established by the supplier of water.

3. Backflow Education Program Minimum Requirements

The Cross-Connection Education Program, Recommended Learning Objectives document is intended to provide the supplier of water a framework for developing educational materials for implementing an educational program as required by OAC rule 3745-95-04(C)(2)(e).

The supplier of water is required to develop and implement a backflow education program to educate all consumers on the dangers of cross-connections and how to eliminate cross-connections when the alternative to the installation of an approved backflow preventer is offered. If the supplier of water does not offer this option, a backflow education program is not required, although it is strongly encouraged as a component of all backflow prevention programs.

The method of delivery is not specified by rule but may include: mail, posting on the internet, public meetings, hand delivery, publication in newspaper(s), and inclusion in the consumer confidence report or public service announcements. Educational materials may include brochures, fact sheets, audio and video recordings, posters and presentations.

4. Educational Brochure

"Backflow Prevention and Cross-Connection Control, Protecting Our Public Water System" is a brochure the Division of Drinking and Ground Waters (DDAGW) developed as an educational tool for water systems to assist in achieving compliance with the educational program required by OAC rule 3745-95-04(C)(2)(e). The brochure covers the information DDAGW believes customers need to know about backflow prevention and complying with Ohio backflow prevention rules. The brochure is available both in "pdf" and "Microsoft Word" formats on the division's website. Public water systems are not required to utilize this brochure and may utilize material from other sources or develop their own educational materials.

All program material used by a PWS must be available for review by Ohio EPA Division of Drinking and Ground Waters.

IV. ATTACHMENTS

A. Instructions for Completing Annual Survey for Auxiliary Water Systems
B. Annual Survey for Auxiliary Water Systems
C. Cross-Connection Education Program Requirements and Recommended Learning Objectives
D. Recommended Agreement Language
E. Backflow Prevention and Cross Connection Control, Protecting Our Public Water System.

V. HISTORY

The Division of Drinking and Ground Waters first issued this guidance on March 16, 2004 and revised on June 11, 2004. The guidance was amended to include new rule language in the guidance and the educational brochure, and was reissued on October 15, 2015.

Instructions for Completing
Annual Survey for Auxiliary Water Systems

Introduction
An approved backflow preventer shall be installed on each service connection serving any customer that has an auxiliary water system, unless the supplier of water determines, on a case-by-case basis, that the installation of an approved backflow preventer on a service connection is not required. This decision must take into consideration several risks which are described below. The public water system is required to conduct or cause to be conducted an inspection at least every twelve months to certify that no connection or means of connection has been created between the public water system and the auxiliary water system. " Auxiliary water system" means any water system on or available to the premises other than the public water system.

The "Annual Survey for Auxiliary Water Systems" is intended to be used by public water systems or their representatives during an inspection for documentation purposes and to help evaluate if the alternative to installation of an approved backflow preventer is appropriate. This survey may be used for both the initial and annual surveys. The survey form consists of three sections to help ensure the collection of pertinent information. The instructions provide an explanation for each section of the survey. It is the responsibility of the public water system to make the final determination if the alternative to the installation of an approved backflow preventer will be permitted.

Completing the Survey
The survey is designed to direct the surveyor in such a manner as to address all the risk factors that must be reviewed in accordance with Ohio Administrative Code (OAC) rule 3745-95-04(C)(2)(a). These risk factors include, but are not limited to, the past history of cross-connections being established or re-established on the premises, the ease or difficulty of connecting the auxiliary water system with the public water system on the premises, the presence or absence of contaminants on the adjacent real property or other risk factors.

The opening paragraph must be completed to include the water system name, date and address of the premises served by the public water system. You may want to include additional site information such as account number or other identifiers for tracking purposes.

Potential Contaminant Source Inventory: A table has been designed to determine if any potential contaminant sources, that represent a backflow hazard, are present on the real property or premises. Real property refers to the land surrounding the premises and is owned or controlled by the consumer of water. " Premises" is defined in the Ohio Administrative Code as any building, structure, dwelling or area containing plumbing or piping supplied from a public water system. If any potential contaminant source, including an auxiliary water system, is connected to the public water system or otherwise contained on the premises, an appropriate

backflow preventer is required by OAC rule 3745-95-02, unless the actual or potential cross-connections are abated or controlled to the satisfaction of the supplier of water.

Example Table

Potential Contaminant Source	Present (Y/N) on		Connected to PWS or Auxiliary System (AS)	Comments
	Adjacent Property	Premises		
Feed lot/livestock holding area/barnyard	Y	N	PWS [ ] AS [X]	Barn with horses
Irrigation system	Y	Y	PWS [ ] AS [X]	Control valving within the house served by PWS.

In the above example the barn connected to the auxiliary system would not necessitate the need for a backflow preventer on the service line. However, the irrigation system on the premises would require a backflow preventer be installed on the service connection serving the house in accordance with OAC rule 3745-95-02. This is due to the auxiliary water system containing a portion of its plumbing within the premises even though there is no direct connection.

Auxiliary Water System Information: Questions #2 and #3 are intended to evaluate the ease or difficulty in establishing a cross-connection between the auxiliary water system and the public water system. There is no minimum separation distance established by the Ohio Administrative Code and must be determined by the public water system on a case-by-case basis. A consistent approach is recommended. Tap-to-tap connections have occurred in the past with the use of a garden hose. This fact may help in establishing minimum separation requirements between the auxiliary water system and the public water system. A drawing should be developed during the initial survey that indicates the location of any auxiliary water system(s) and the distance(s) from the premises. This drawing should be reviewed during subsequent annual surveys to ensure no changes have been made that would necessitate the need for the installation of a backflow preventer.

Past Problems/Ease of Establishing a Cross-connection: Questions #4 through #7 are intended to identify past problems and further evaluate the ease of establishing a cross-connection. If any of these questions are answered "Yes" then it is recommended a backflow preventer be required on the service line unless appropriate corrective actions have been taken as determined by supplier of water.

The surveyor has the option of either requiring or not requiring the installation of a backflow preventer as a result of the information collected through the survey. If a backflow prevention method or backflow preventer is required, the type should be determined and

documented on the survey form. A space has been provided for the surveyor's comments. This area can be used to justify the decisions made or to note the required corrective actions necessary to allow the option not to install a backflow preventer.

The supplier of water should maintain records of all surveys for a sufficient length of time to document the history of each auxiliary water system. A minimum of five years is required by Ohio EPA for the annual surveys. The inventory records must be kept indefinitely, as long as they remain applicable.

Annual Survey for Auxiliary Water Systems

(*Name of public water system)* _____ hereby certifies that on *(date)* _____ the factors listed below have been evaluated during an on-site survey at *(address)* _____ and have been taken into consideration in determining the need for the installation of a backflow preventer. This evaluation encompasses the premises served by the *(Name)* _____ Public Water System and an auxiliary water system on the real property that is owned or under control of the consumer adjacent to the premises.

1. Check all of the potential contaminant sources that are present and complete the following table[1]:

Potential Contaminant Source	Present (Y/N) **on**		Connected to PWS or **Auxiliary Water System (AS)**	**Comments** (Include description of backflow preventer or method.)
	Adjacent Property	**Premises**		
Boiler/hot water building heat with chemical treatment			PWS ☐ AS ☐	
Swimming pool			PWS ☐ AS ☐	
Feed lot/livestock holding area/barnyard			PWS ☐ AS ☐	
Irrigation system			PWS ☐ AS ☐	
Herbicide/pesticide mixing			PWS ☐ AS ☐	
Is there a business on the property that utilizes water for anything other than potable purposes? If so, what?			PWS ☐ AS ☐	
Other potential backflow hazard(s).			PWS ☐ AS ☐	
Explain:				

[1]If any potential contaminant source is connected to the PWS without an acceptable isolation device or contained on the premises then an appropriate backflow preventer may be required by OAC rule 3745-95-02. By definition, if there is a connection to the public water system, the potential contaminant source is on the premises.

2. List all auxiliary water systems. Include a drawing of the auxiliary water systems and show the distance auxiliary water systems are from all structures, property lines and locations of any items listed above.

3. What is the minimum distance between the public water system piping and the auxiliary water system?

4. Yes ☐ No ☐ Is there any reason to believe the physical separation has been tampered with or compromised in any way? If yes, describe:

5. Yes ☐ No ☐ Have unprotected cross-connections ever occurred? If yes, describe. Include dates of occurrence.

6. Yes ☐ No ☐ Is there a temporary or permanent means available on the premises for the purpose of cross-connecting the auxiliary water system with the public water system? If yes, describe:

7. Yes ☐ No ☐ Is plumbing from an auxiliary water system inside any buildings, structures, dwellings or areas which are served by the public water system? If yes, describe:

Survey Results:

☐ The following approved method or device is required on each service connection:
  ☐ An air gap;
  ☐ A reduced pressure principle backflow prevention (RP) assembly; or
  ☐ A double check valve assembly (DCVA);

OR

☐ A backflow preventer on each service connection is not required.

Surveyor Comments: _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Surveyor (print): _____

Surveyor Signature: _____

Date: _____

This survey must be maintained by the supplier of water for at least 5 years.

Cross-Connection Education Program
Requirements and Recommended Learning Objectives

Educational Program Requirements:
The requirement to develop and implement a cross-connection education program is only required if a public water system decides to offer the alternative to the installation of an approved backflow preventer under Ohio Administrative Code (OAC) rule 3745-95-04. If the alternative is offered then OAC rule 3745-95-04(C)(2)(e) requires that a cross-connection education program be developed and implemented to inform all consumers about the dangers of cross-connections and how to eliminate them.

Recommended learning objectives have been established to assist in the development of a more comprehensive cross-connection educational program. In addition, Ohio EPA-DDAGW has developed an educational brochure that can be used by a public water system to address the recommended learning objectives.

Even if a public water system does not intend to offer the alternative to the installation of a backflow preventer for auxiliary water systems, it is recommended that an outreach effort be made to educate the consumers about the dangers of cross-connections. Education is considered an integral part of any backflow prevention program.

The method of implementation of a cross-connection education program is not specified by rule but may include: mail, posting on the Internet, public meetings, hand delivery, publication in newspaper(s), and inclusion in the Consumer Confidence Report or public service announcements. Educational materials may include brochures, fact sheets, posters, audio and video recordings, and presentations. It is intended that the educational program be implemented in such a manner as to reasonably reach all consumers particularly those that have or potentially have an auxiliary water system available to their property.

Recommended learning objectives:
1. To provide a basic understanding of backflow, the associated dangers and the importance of prevention.

2. To provide the consumer an elementary understanding of common conditions that could result in a backflow hazard and what constitutes a cross-connection.

3. To provide a consumer with sufficient information to make an informed decision as it applies to cross-connections when considering plumbing modifications.

4. To inform the consumer of their rights and the rules, regulations and policies that govern backflow prevention, including the penalties associated with creating a cross-connection.

Recommended Agreement Language[1]
OAC rule 3745-95-04(C)(2)(b)
Alternative to Installation of an Approved
Backflow Preventer on Auxiliary Water System

General Requirements for Consumer Agreement:
Any agreement intended to achieve compliance with OAC rule 3745-95-04(C)(2)(b) must contain language which specifies the penalties, including those set forth in OAC rule 3745-95-08, for creating a connection between the public water system and the auxiliary water system. Definitions of terms such as premises, real property, consumer's water system, auxiliary water system, cross-connection, etc., should be clearly defined.

Suggested Language to Include in Consumer Agreement:
No person shall install or maintain a water service connection to any premises where actual or potential cross-connections to a public water system or a consumer's water system may exist unless such actual or potential cross-connections are abated or controlled to the satisfaction of {the supplier of water}.

(A) No person shall install or maintain a connection between a public water system or consumer's water system and an auxiliary water system.

(B) Those consumer's that have an auxiliary water system as defined in OAC rule 3745-95-01 shall install an approved backflow preventer on the service line to each premises on the consumer's real property, except:

1) Where {the supplier of water} determines, on a case-by-case basis, that the installation of an approved backflow preventer on a service connection is not required in consideration of factors including, but not limited to, the past history of cross-connections being established or re-established on the premises, the ease or difficulty of connecting the auxiliary water system with the public water system on the premises, the presence or absence of contaminants on the property or other risk factors; and

2) The consumer signs an agreement not to create a connection between the public water system and the auxiliary water system and all associated penalties including but not limited to, discontinuance of service for failure to comply with the conditions of the agreement; and

3) Permits {the supplier of water} or an appointed representative the right to enter upon reasonable notification the consumer's property and premises for the purpose of conducting an inspection at least every twelve months to certify that no connection or means of connection has been created between the public water system and the auxiliary water system.

(C) Water service will be denied or discontinued, after reasonable notice to the occupant thereof, the water service to any premises wherein any backflow preventer required is not installed, tested and maintained in a manner acceptable to the {the supplier of water}, or if it is found that the backflow preventer has been removed or by-passed, or if an unprotected cross-connection exists on the premises, or if {the supplier of water} personnel, or authorized representative, is denied entry to determine compliance with backflow requirements.

(D) Water service to such premises shall not be restored until the consumer has corrected or eliminated such conditions or defects in conformance with all applicable rules and regulations, and to the satisfaction of {the supplier of water}.

(E) Additional provisions established by the supplier of water.

[1]Language equivalent to paragraphs A, C & D are required and paragraph B is recommended. The recommended language may need to be modified or supplemented depending on the public water system ordinances, policies, rules, regulations or user agreements. Any agreement or language developed for the intended use for compliance with OAC rule 3745-95-04(C) should be reviewed and approved by the public water system's legal counsel.

If a potential or actual cross-connection contamination hazard is identified, the customer will be required to eliminate the hazard and/or install an appropriate backflow preventer at the service connection and/or at the hazard.

Special Conditions

Auxiliary Water Systems

What is an auxiliary water system?

It is any water system on or available to your property other than the public water system. Used water or water from wells, cisterns or open reservoirs that are equipped with pumps or other sources of pressure, including gravity are examples.

What protection is required?

- The auxiliary water system must be completely separated from water supply plumbing served by a public water system; and
- An approved backflow preventer must be installed at the service connection (where the public water system connects to the customer's plumbing system).

OR

- The auxiliary water system must be eliminated.

Are there exceptions?

At their discretion, the water supplier may waive the requirement for a backflow preventer at the service connection if all the following conditions are met:

- All components of the auxiliary water system, including pumps, pressure tanks and piping, are removed from the premises, which are defined as all buildings, dwellings, structures or areas with water supply plumbing connected to the public water system.
- The possibility of connecting the auxiliary water system to the water supply plumbing is determined by the water supplier to be extremely low.
- No other hazards exist.
- The customer enters into a contract with the water supplier, as described below.

The contract will require the customer:

- To understand the potential hazard of a cross-connection.
- To never create a cross-connection between the auxiliary water system and the public water system.
- To allow an inspector to survey their property for hazards as long as the contract is in effect.
- To face loss of service and other penalties if the contract is violated.

The water supplier must perform an annual inspection of the customer's contract-regulated property to verify the conditions have not changed, which would warrant installation of a backflow preventer. The water supplier must, by law, do everything reasonably possible to protect the water system from contamination.

Booster Pumps

What is the concern?

Booster pumps connected to plumbing systems or water mains can cause backsiphonage by reducing the water mains. The following requirements are in place to help prevent backsiphonage:

- Booster pumps, not used for fire suppression, must be equipped with a low suction cut-off switch that is tested and certified every year;
- Alternately, when a booster pump is necessary for one-, two- and three-family dwellings, it is preferred that the booster pump draw from a surge tank filled through an air gap; and
- Booster pumps, used in a fire suppression system, must be equipped with either a low suction throttling valve on the discharge side or be equipped with a variable speed suction limiting control system. Low-pressure cut-off devices will suffice for fire pumps installed prior to August 8, 2008, until a significant modification is warranted, at which point the minimum pressure sustaining method must be updated. Each of these methods must be tested and certified each year.

Contacts

Need more information?

Questions concerning backflow prevention and cross-connection control may be directed to your local water department or to your local Ohio EPA District Office at the following numbers:

Northwest District	**(419) 352-8461**
Northeast District	**(330) 963-1200**
Southwest District	**(937) 285-6357**
Southeast District	**(740) 385-8501**
Central District	**(614) 728-3778**

Questions regarding internal plumbing in the home may be directed to your local plumbing authority or to the Ohio Department of Commerce, Plumbing Administrator, at (614) 644-3153.

John Kasich, Governor
Craig W. Butler, Director

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Ohio Environmental Protection Agency

Backflow Prevention and Cross-Connection Control

Protecting our Public Water System

August 2015

Division of Drinking and Ground Waters
P.O. Box 1049
Columbus, Ohio 43216-1049
(614) 644-2752
www.epa.ohio.gov

What is a cross-connection?

Any physical connection created between a possible source of contamination and any drinking water system piping.

What is backflow?

It is the flow through a cross-connection from a possible source of contamination back into the drinking water system. It occurs when a cross-connection is created and a pressure reversal, either as backsiphonage or backpressure, occurs in the water supply piping.

Why be concerned?

- ALL cross-connections pose a potential health risk.
- Backflow can be a health hazard for your family or other consumers if contaminated water enters your water supply plumbing system and is used for drinking, cooking or bathing. Chemical burns, fires, explosions, poisonings, illness and death have all been caused by backflow through cross-connections.
- Backflow occurs more often than you think.
- You are legally responsible for protecting your water supply plumbing from backflow that may contaminate drinking water, either your own or someone else's. This includes complying with the plumbing code and not creating cross-connections.

What causes backsiphonage?

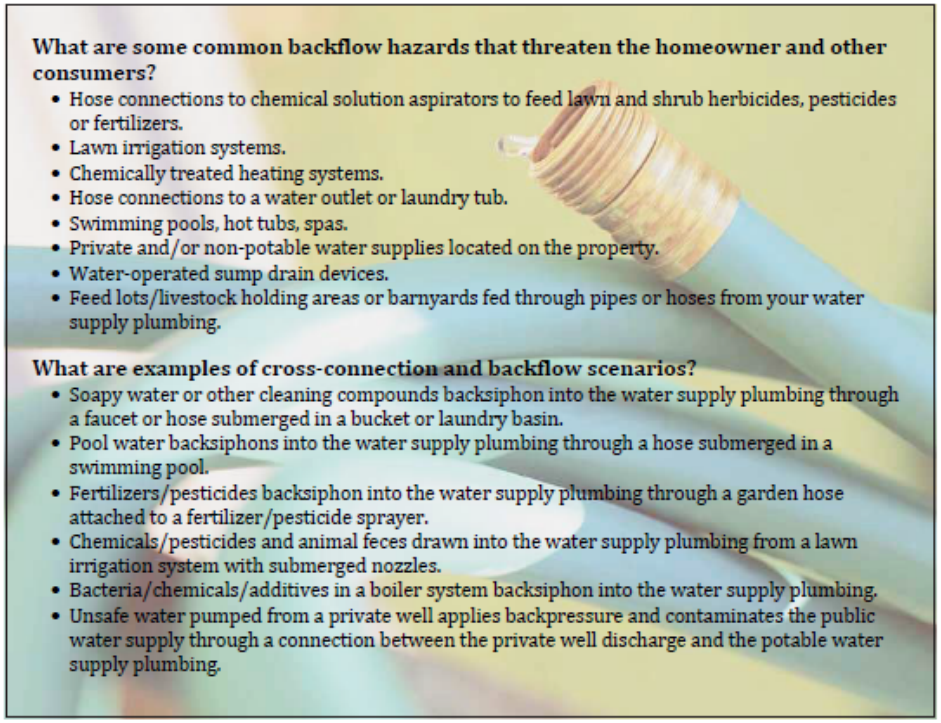
Backsiphonage occurs when there is a loss of pressure in a piping system. This can occur if the water supply pressure is lost or falls to a level lower than the source of contamination. This condition, which is similar to drinking from a glass with a straw, allows liquids to be siphoned back into the distribution system.

What causes backpressure?

Backpressure occurs when a higher opposing pressure is applied against the public water system's pressure. This condition allows undesirable gases or liquids from another system to enter the drinking water supply. Any pumping system (such as a well pump) or pressurized system (such as steam or hot water boilers) can exert backpressure when cross-connected with the public water system.

What can I do?

- Be aware of and eliminate cross-connections.
- Maintain air gaps. Do not submerge hoses or place them where they could become submerged.
- Use hose bib vacuum breakers on fixtures (hose connections in the basement, laundry room and outside).
- Install approved, testable backflow preventers on lawn irrigation systems.
- Do not create a connection between an auxiliary water system (well, cistern, body of water) and the water supply plumbing.



What are some common backflow hazards that threaten the homeowner and other consumers?

- Hose connections to chemical solution aspirators to feed lawn and shrub herbicides, pesticides or fertilizers.
- Lawn irrigation systems.
- Chemically treated heating systems.
- Hose connections to a water outlet or laundry tub.
- Swimming pools, hot tubs, spas.
- Private and/or non-potable water supplies located on the property.
- Water-operated sump drain devices.
- Feed lots/livestock holding areas or barnyards fed through pipes or hoses from your water supply plumbing.

What are examples of cross-connection and backflow scenarios?

- Soapy water or other cleaning compounds backsiphon into the water supply plumbing through a faucet or hose submerged in a bucket or laundry basin.
- Pool water backsiphons into the water supply plumbing through a hose submerged in a swimming pool.
- Fertilizers/pesticides backsiphon into the water supply plumbing through a garden hose attached to a fertilizer/pesticide sprayer.
- Chemicals/pesticides and animal feces drawn into the water supply plumbing from a lawn irrigation system with submerged nozzles.
- Bacteria/chemicals/additives in a boiler system backsiphon into the water supply plumbing.
- Unsafe water pumped from a private well applies backpressure and contaminates the public water supply through a connection between the private well discharge and the potable water supply plumbing.

What must be done to protect the public water system?

The public water supplier must determine potential and actual hazards. If a hazard exists at a customer's public water supply service connection, the customer will be required to install and maintain an appropriate backflow preventer* at the meter and/or at the source of the hazard.

*Check with your water supplier to verify which backflow preventer is required before purchase or installation.

Who is responsible?

In Ohio, the responsibility for preventing backflow is divided. In general, state and local plumbing inspectors have authority over plumbing systems within buildings while Ohio EPA and water suppliers regulate protection of the distribution system at each service connection.

Water customers have the ultimate responsibility for properly maintaining their plumbing systems. It is the homeowner's or other customer's responsibility to ensure that cross-connections are not created and that any required backflow preventers are tested yearly and are in operable condition.

What is the law?

Ohio Administrative Code Chapter 3745-95 requires the public water supplier to protect the public water system from cross-connections and prevent backflow situations. The public water supplier must conduct cross-connection control inspections of their water customers' property to evaluate hazards. Local ordinances or water department regulations may also exist and must be followed in addition to state regulations.

METHOD FOR ACCOMPLISHING PERIODIC SURVEYS AND INVESTIGATIONS OF EXISTING SERVICE CONNECTIONS

The following guidance can be used to assist a PWS in determining how to fulfill the periodic survey and investigations requirement in OAC Rule 3745-95-03. Surveys may consist of a paper questionnaire completed by the consumer or supplier of water and/or reviewing of plans/permits. An investigation includes a physical onsite inspection.

1. At a minimum, an investigation must be conducted for each service connection where a likely hazard exists. These onsite investigations must occur every five years.

2. To achieve these onsite investigations, at least a sampling of active service connection for all categories of water users should be investigated every year to confirm whether or not a new or increased hazard is present and to properly address the added risk. Consider the following methodology:

   A. Categorize service connections by type (i.e., commercial, industrial, institutional, residential) and further by water-use practice tendencies (i.e., restaurants, car washes, manufacturing type, apartment building). Standard Industrial codes, or what is now called the North American Industry Classification System (NAICS), as provided by state and federal government agencies, may be used to assist in categorizing types of water users. Each business is assigned a code through the classification system. These codes can be found online by conducting a search. One listing can be found at: http://www.census.gov/eos/www/naics/

   B. Select a subset of each type of water user and conduct the onsite investigations of them to represent the categories of users.

   C. Determine if any changes in water use practices have occurred or an increase in the degree of hazard is possible. For example, changes in water use practices can consist of: a new process/chemical used where water provides for dilution and the hazard increased; a booster pump was added; or an irrigation system was installed.

      1. If results indicate the possibility that the degree of hazard has increased, the supplier of water must ensure the proper level of protection against backflow is provided.

      2. If an onsite investigation shows no change in the degree of hazard, further action is not necessary at that time.

3. In lieu of conducting onsite investigations of the consumers' premises likely to have a hazard, the water purveyor can document, in writing, a different methodology to

identify and address, on an on-going basis, new or increased, actual or potential, hazards to the water supply. Survey questionnaires can be used or triggers to help identify when a consumer's premises will require an onsite investigation. If a likely hazard exists, an onsite investigation is required to ensure the risk is mitigated.

A. Surveys may consist of a paper or electronic questionnaire completed by the consumer or supplier of water. The questionnaire must inquire about water use practices, connections to plumbing and types of backflow prevention on plumbing and should be tailored to include common hazards typically found at the type of premises. Review of plans can also be used.

B. Triggers can include notification from a licensing authority that a change in water use practice has occurred at a premises. Where they exist, collaboration with other licensing agencies, including but not limited to, local building, zoning, health, and fire protection, which are often notified when changes in water use practices are proposed, is strongly recommended. In addition, where the water purveyor has jurisdiction, events such as requests for a larger or additional meter, or a new or additional service line, would warrant an onsite investigation.

An onsite inspection is required if a change in water use practice likely represents a new or increased hazard. The approach taken should be one that is deemed necessary to determine whether or not changes in water use practices have occurred, cross-connections have been created, and the appropriate level of backflow protection is in place.

4. In lieu of conducting an on-site investigation of each residential premises without a likely hazard, the supplier of water may institute an on-going educational campaign to inform consumers of common backflow hazards created during residential water use and provide a reporting mechanism for suspected cross-connections. An education campaign may use local media and advertising resources, but must also include information delivered, either electronically or hard copy, to each residential service connection at least annually.

5. Periodic surveys and investigations are intended to supplement the initial assessment, which is completed by the supplier of water when providing a public water system service connection to the premises. Periodic surveys and investigations do not take the place of testing and inspection requirements found in other sections of OAC 3745-95. An opportunity does exist, however, to conduct periodic surveys and investigations at the time of testing and inspection for those premises having existing containment protection.

APPENDIX VII

BIBLIOGRAPHY

American National Standards Institute. Air Gaps in Plumbing Systems. ANSI A112.1.2-1991. (1992)

American Water Works Association. AWWA Standard for Backflow Prevention Devices – Reduced Pressure Principle and Double Check Valve Types. AWWA C506-78 (Jan. 28, 1978).

American Water Works Association. Recommended Practice for Backflow Prevention and Cross-Connection Control. Manual of Water Supply Practices M-14. American Water Works Association (2004).

Angele, G. J., Sr., et al. Backflow Prevention and Cross-Connection Control. Manual M-14. American Water Works Association (1966). An extensive bibliography was added to AWWA Manual M-14 in 1970.

Angele, G. J., Sr. Cross-Connections and Backflow Prevention. Second Edition. American Water Works Association (1974).

Foundation for Cross-Connection Control and Hydraulic Research. Manual of Cross-Connection Control. Seventh Edition. University of Southern California (1985).

Foundation for Cross-Connection Control and Hydraulic Research. Manual of Cross-Connection Control. Ninth Edition. University of Southern California (1993).

Great Lakes-Upper Mississippi River Board of State Public Health Environmental Managers. Recommended Standards for Water Works. (1982). Health Education Services, P.O. Box 7283, Albany, N.Y. 12224.

Great Lakes-Upper Mississippi River Board of State Public Health Environmental Managers. Recommended Standards for Water Works. (2003). Health Education Services, P.O. Box 7283, Albany, N.Y. 12224.

Department of Health, Education and Welfare Publication 957. Water Supply and Plumbing Cross-Connections, Hazards in Household and Community Supply Systems. U.S. Government Printing Office, Washington D.C. (1963).

Ohio Department of Commerce, Industrial Compliance, Backflow Section. Backflow Prevention & Cross-Connection Control Manual, for the Education of Ohio Certified Backflow Prevention Technicians. Reynoldsburg, Ohio (2009)

Operator Training Committee of Ohio. Backflow Prevention Refresher Manual. Columbus, Ohio (March 2010).

Operator Training Committee of Ohio. Backflow Prevention Student Manual. Columbus, Ohio (March 2010).

National Fire Protection Association. NFPA 13: Standard for Installation of Sprinkler Systems, ed. 2010. Pages 13-38, 13-86, 13-91, 13-92, 13-236, 13-290.

National Fire Protection Association. NFPA 20: Standard for Installation of Stationary Pumps for Fire Protection, ed. 2010. Pages

National Fire Protection Association. NFPA 25: Standard for Inspection, Testing and Maintenance of Water-Based Fire Protection Systems, ed. 2008. Pages 25-8, 25-12, 25-45, 25-51.

U.S. Environmental Protection Agency Office of Water Programs, Water Supply Division. Cross-Connection Control Manual. U.S. Government Printing Office, Washington D.C. (1974).

U.S. Environmental Protection Agency Office of Water Programs, Office of Ground Water and Drinking Water. Cross-Connection Control Manual. EPA 816-R-03-002. U.S. Government Printing Office, Washington D.C. (2003).